

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



DOT/FAA/PM-86/47

Program Engineering and Maintenance Service Washington, D.C. 20591 FAA Helicopter/Heliport Research, Engineering, and Development Bibliography, 1964–1986

Robert D. Smith
Federal Aviation Administration
Program Engineering and
Maintenance Service
Washington, D.C. 20591

November 1986

Bibliography

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Ly This bibliography was

- 1. INTRODUCTION. This report has been assembled as an aid for those who are interested in helicopter/heliport research, engineering, and development. This includes those within the Federal Aviation Administration (FAA), those in industry, and those in state and local governments.
- 2. SCOPE. SIn selecting documents to be included in this report, two limitations have been observed. First, the documents are specifically related, in whole or in part, to helicopter operations. Second, they are limited to documents in which the research, engineering, and development elements (i.e., the ADL Complex) of the FAA have been involved as sponsors, participants, or authors. Citations include a between the Author and subject indexes are provided.
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 - b. American Helicopter Society (AHS). Copies of virtually all of the documents listed in this report have been given to AHS. Both AHS members and nonmembers may obtain copies of reports for a small fee.
 - c. Helicopter Association International (HAI). Copies of virtually all of the documents listed in this report have been given to HAI. HAI members may obtain copies of reports for a small fee.
- 4. ORDER OF THE LISTING. In the bibliographic listing, documents are listed in order of the year in which they were published. Within the year of publication, documents are listed sequentially according to report number. Some documents do not include the year of publication as part of report number. Such a document is listed after other documents published in the same year. (e.g., NAE-AN-26, published in 1985, is listed after the other reports published in 1985.)

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RD-64-55	Analytical Determination of the Velocity Fields in the Wakes of Specified Aircraft (W.J. Bennett)
NA-67-1 DS-67-23	An Analysis of the Helicopter Height Velocity Diagram including a Practical Method for its Determination (William J. Hanley, Gilbert Devore)
NA-68-21 RD-67-68	VTOL and STOL Simulation Study (Robert C. Conway)
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FAA-RD-71-96 FAA-NA-71-45	Analytical Study of the Adequacy of VOR/DME and DME/DME Guidance Signals for V/STOL Area Navigation in the Los Angeles Area (Bernhart V. Dinerman)
FAA-RD-71-105	Heliport Beacon Design, Construction, and Testing (Fred Walter)
FAA-RD-72-133 FAA-NA-72-89	Flight Test and Evaluation of Heliport Lighting for IFR (Thomas H. Paprocki)
FAA-RD-73-47 FAA-NA-72-95	ATC Concepts for V/STOL Vehicles, Parts 1 and 2 (Sidney 8. Rossiter, John Maurer, Paul J. O'Brien)
FAA-RD-73-145	V/STOL Noise Prediction and Reduction (Wilev A. Guinn, Dennis F. Blakney, John S. Gibson)
FAA-RD-74-48 FAA-NA-73-68	A Summary of Helicopter Vorticity and Wake Turbulence Publications with an Annotated Bibliography (Jack J. Shrager)
FAA-RD-75-79	A Comprehensive Review of Helicopter Noise Literature (B. Magliozzi, F.B. Metzger, W. Bausch, R.J. King)
FAA-RD-75-94	Wind and Turbulence Information for Vertical and Short Take-Off and Landing (V/STOL) Operations in Built-Up Urban Areas-Results of Meteorological Survey (J.V. Ramsdell)

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FAA-RD-76-49	V/STOL Rotary Propulsion Systems - Noise Prediction and Reduction (8. Magliozzi)
Vol-I	Identification of Sources, Noise Generating Mechanisms, Noise Reduction Mechanisms, and Prediction Methodology
Vol-III Vol-III	Graphical Prediction Methods Computer Program User's Manual
FAA-RD-76-116	Noise Certification Considerations for Helicopters Based on Laboratory Measurements (MAN-Acoustics and Noise)
FAA-RD-76-146	A Comparison of Air Radio Navigation Systems (For Helicopters In Off-Shore Areas) (George H. Quinn)
FAA-RD-77-57	Helicopter Noise Measurements Data Report (Harold C. True, Richard M. Letty)
Vol-I	Helicopter Models: Hughes 300-C, Hughes 500-C, Bell 47-G, Bell 206-L
Vol-II	Helicopter Models: Bell 212 (UH-IN), Sikorsky S-61 (SH-3A), Sikorsky S-64 "Skycrane" CH-54B, Boeing Vertol "Chinook" (CH-47C)
FAA-RD-77-94	Noise Characteristics of Eight Helicopters (Harold C. True, E.J. Rickley)
FAA-RD-77-100	Study to Improve Turbine Engine Rotor Blade Containment (K.F. Heermann, R.H. Eriksson, K.R. McClure)
NA-78-55-LR	Limited Test of LORAN-C and Omega for Helicopter Operations in the Offshore New Jersey Area (Robert H. Pursel)
FAA-RD-78-101	Helicopter Operations Development Plan
FAA-RD-78-143	Aircraft Wake Vortex Takeoff Tests at Toronto International Airport (Thomas Sullivan, James Hallock, Berl Winston, Ian McWilliams, David C. Burnham)
FAA-RD-78-150	Helicopter Air Traffic Control Operations
FAA-RD-78-157	Review of Airworthiness Standards for Certification of Helicopters for Instrument Flight Rules (IFR) Operations (Joseph J. Traybar, David L. Green, Albert G. Delucien)

FAA-RD-79-59	Powered-Lift Aircraft Handling Qualities in the Presence of Natually-Occurring and Computer-Generated Atmospheric Disturbances (Wayne F. Jewell, Warren F. Clement, Thomas C. West, Dr. S.R.M. Sinclair)
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FAA-RD-81-7-LR	Three Cue Helicopter Flight Directors: An Annotated Bibliograph (Tosh Pott, J.P. McVicker, Hebert W. Schlickenmaier)
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PM-85-2-LR	Heliport Design Guide, Workshop Report Volume 1: Executive Summary
PM-85-3-LR	Volume 2: Appendixes
PM-85-4-LR	Volume 3: Viewqtaphs

FAA/CT-TN85/5	Gulf of Mexico Helicopter Loran C Stability Study (Roseann M. Weiss)
FAA/PM-85/6	Helicopter User Survey: TCAS (Frank R. Taylor)
FAA/PM-85/7	MLS for Heliport Operators, Owners, and Users (Kristen J. Venezia, Edwin D. McConkey)
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FAA/CT-TN85/17	Nonprecision Approaches in the Northeast Corridor Using Second Generation Loran Receivers (Barry Billmann, John G. Morrow. Christopher Wolf)
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FAA/CI-TN85/83	Rotorcraft TCAS Evaluation Bench Test Report (Arthur W. Cushman, Albert J. Rehmann, John Warren)
NAE-AN-26 NRC No. 24173	A Preliminary Investigation of Handling Qualities Requirements for Helicopter Instrument Flight During Decelerating Approach Manoeuvres and Overshoot (Stan Kereliuk, J. Murray Morgan) February 1985
FAA/PM-86/10	Very Short Range Statistical Forecasting of Automated Weather Observations (Robert G. Miller)
FAA/CT-TN86/14	Heliport MLS Flight Inspection Project (Scott Shollenberger, Barry R. Billmann)
FAA/PM-86/14 NASA CR-177407	Technical Requirements for Benchmark Simulator-Based Terminal Instrument Procedures (TERPS) Evaluation (Anil V. Phatak. John A. Sorensen)
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FAA/PM-86/30 FAA/CT-86-9	The Siting. Installation, and Operational Suitability of the Automated Weather Observing System (AWOS) at Heliports (Rene A. Matos, John R. Sackett, Philip Shuster, Rosanne M. Weiss)
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FAA/PM-86/45	Aeronautical Decision Making for Helicopter Pilots (Richard J. Adams, Jack L. Thompson)
FAA/AVN-200/25	Helicopter Microwave Landing System (MLS) Flight Test (Charles Hale, Paul Maenza) June 1986

APPENDIX B: SUBJECT INDEX

ACCIDENTS

FAA/CT-83/40 FAA/CT-85/11

ADVANCING BLADE CONCEPT HELICOPTER

FAA-RD-78-150

AIR TRAFFIC CONTROL

RD-64-4	RD-64-55	NA-68-21
FAA-RD-73-47	FAA-RD-78-101	FAA-RD-78-150
FAA-RD-79-123	FAA-RD-80-59	FAA-RD-80-80
FAA-RD-80-85	FAA-RD-80-86	FAA-RD-80-87
FAA-RD-80-88	FAA-RD-81-55	FAA-RD-81-59
FAA/CT-TN86/17		

AIRBORNE RADAR APPROACHES

FAA-KD-78-101	FAA-RD-78-150	FAA-RD-79-99
FAA-RD-80-18	FAA-RD-80-22	FAA-RD-80-59
FAA-RD-80-60	FAA-RD-80-85	FAA-RD-80-88,II
PAA /PD-82/6	FAA/RD~82/40	

AIRWORTHINESS

FAA-RD-78-157 FAA/CT-85/26

AREA NAVIGATION (RNAV) (See also GPS, LORAN-C, and MLS RNAV)

FAA-RD-71-96	FAA-RD-76-146	FAA-RD-78-150
FAA-RD-80-17	FAA-RD-80-64	FAA-RD-80-80
FAA-RD-80-85	FAA-CT-80-175	FAA-RD-81-59
FAA/RD-82/6	FAA/RD-82/7	FAA/CT-82/57
FAA/PM-86/25,1		

AUTOMATED WEATHER OBSERVING SYSTEM (AWOS)

FAA/RD-81/40 FAA/CT-TN/85/23 FAA/PM-86/30

AVIONICS EQUIPPAGE

FAA/PM-86/25,I

AWOS GEM

FAA/PM-84/31 FAA/PM-86/10

AUTOMATIC DEPENDENT SURVEILLANCE (See LOFF)

AUTOMATIC DIRECTION FINDER (See Nondirectional Beacon)

AUTOROTATION

NA-67-1 FAA/PM-86/28

AVIONICS, AIRBORNE RADAR APPROACHES

FAA-RD-79-99 FAA-RD-80-18 FAA-RD-80-22

FAA-RD-80-60

AVIONICS, COMMUNICATIONS

FAA/PM-85/8

AVIONICS, GPS (See also GPS)

FAA/RD-82/8 FAA/RD-82/9 FAA/RD-82/63 FAA/RD-82/71 FAA/CT-82/103 FAA/CT-TN83/03

FAA/CT-TN83/50 FAA/CT-84/47

AVIONICS, LORAN-C (See also LORAN-C and LOFF)

FAA/RD-82/78 FAA/CT-TN85/17

AVIONICS, MLS

FAA/RD-82/40 FAA/CT-TN85/63

AVIONICS, TCAS (See TCAS)

CHARTING

FAA-RD-78-150

COLLISION AVOIDANCE SYSTEM (See also TCAS)

FAA-RD-80-88, I FAA-RD-81-59

COST/BENEFITS

FAA/RD-82/40 FAA/RD-82/6 FAA/PM-84/22

CRASHWORTH INESS

FAA-RD-78-101 FAA/CT-85/11

DECELERATING APPROACHES (See Low Speed Approaches and MLS)

DEPENDENT SURVEILLANCE (See also LOFF)

FAA-RD-80-85

DISTANCE MEASURING EQUIPMENT (DME)

FAA-RD-71-96	FAA-RD-76-146	FAA-RD-80-17
FAA/RD-82/6	FAA/RD-82/63	FAA/RD-82/78
FAA/PM-86/14	FAA/PM-86/15	FAA/PM-86/25,I

DOPPLER NAVIGATION

FAA-RD-76-146

FLIGHT CONTROLS

FAA-RD-78-157	FAA-RD-79-64	FAA-RD-80-64
FAA/PM-86/14	FAA/PM-86/15	NAE-AN-26 (1985)

FLIGHT DIRECTORS

FAA-RD-78-157	FAA-RD-81-7-LR	FAA/PM-86/25,I
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FLIGHT DISPLAYS

FAA-RD-78-157 FAA/PM-85/30

FLIGHT INSPECTION

FAA/CT-86/14 FAA/PM-85/7

GENERALIZED EQUIVALENT MARKOV (GEM) (See Weather Porecasts, and AWOS GEM)

GLOBAL POSITIONING SYSTEM (GPS)

FAA-RD-76-146	FAA-RD-78-101	FAA-RD-78-150
FAA-RD-80-85	FAA/RD-82/6	FAA/RD-82/8
FAA/RD-82/9	FAA/RD-82/63	FAA/RD-82/71
FAA/RD-82/103	FAA/CT-TN83/03	FAA/CT-1N83/50
FAA/CT-TN84/47	FAA/PM-86/14	FAA/PM-86/15

GULF OF MEXICO (See also LOFF and Offshore Operations)

FAA-RD-80-47	FAA-RD-80-85	FAA-RD-80-87
FAA-RD-80-88	FAA/RD-81/40	FAA-RD-81-59
FAA/RD-82/7	FAA/CT-TN85/5	

HANDLING QUALITIES

FAA-RD-78-157 FAA-RD-79-59 FAA-RD-79-64 FAA-RD-80-58 FAA-RD-80-64 FAA/CT-83/6 NAE-AN-26 (1985)

HEIGHT-VELOCITY DIAGRAM

NA-67-1 FAA-RD 80-88, II FAA/PM-86/28

HELICOPTER NOISE (See Noise)

HELIPORT DESIGN (See also Heliport Lighting, MLS Siting, and AWOS)

FAA-RD-78-101 FAA-RD-80-107 FAA-RD-81-35 FAA/CT-82/120 FAA/PM-84/22 FAA/PM-84/23 FAA/PM-84/25 FAA/CT-TN84/31 PM-85-2-LK PM-85-3-LR PM-85-4-LR FAA/PM-85/7

HELIPORT LIGHTING/MARKING

NA-69-2 FAA-RD-71-105 FAA-RD-72-133 FAA-RD-78-101 NA-80-34-LR FAA-RD-80-59 FAA/CT-82/120 FAA/CT-TN84/34 FAA/CT-TN86/22

HELICOPTER OPERATIONS STATISTICS

FAA/CT-83/40 FAA/PM-85/6 FAA/CT-85/11

FAA/PM-86/28

HELICOPTER PERFORMANCE

FAA-RD-80-107 FAA/RD-81/35

HELIPORT PLANNING

FAA-RD-80-107 FAA/RD-81/35 FAA/PM-84/22

FAA/PM-84/25

HELIPORT SNOW AND ICE CONTROL

FAA/PM-84/22

HIGH FREQUENCY COMMUNICATION

FAA-RD-78-150

HOLDING PATTERNS

FAA-RD-78-150 FAA-RD-80-59 FAA-RD-80-80

FAA-RD-80-86 FAA-RD-80-88

HUMAN FACTORS (See also Flight Controls, Flight Displays, and TCAS)

FAA-RD-81-59 FAA/CT-83/6 FAA/CT-83/40 FAA/PM-86/28 FAA/PM-86/45

ICING (See also Weather)

FAA-RD-78-101 FAA-RD-80-24 FAA-CT-80-210 FAA/CT-81/35 FAA/CT-83/7 FAA/CT-83/21 FAA/CT-83/22 FAA/PM-84/22 FAA/CT-85/26

INERTIAL NAVIGATION SYSTEM

FAA-RD-76-146 FAA-RD-80-85 FAA/RD-82/7 FAA/RD-82/24

INSTRUMENT LANDING SYSTEM (ILS)

FAA/RD-82/6 FAA/CT-TN85/24 FAA/PM-86/14 FAA/PM-86/15 FAA/PM-86/25,I

LIGHTING (See Heliport Lighting)

LORAN-C (See also LOFF)

FAA-RD-70-10	FAA-RD-76-146	NA-78-55-LR
FAA-RD-78-101	FAA-RD-78-150	FAA-RD-80-20
FAA-RD-80-47	FAA-RD-80-85	FAA-RD-80-87
FAA-RD-80-88	FAA-CT-80-175	FAA-RD-81-27
FAA-RD-81-59	FAA/RD-82/6	FAA/RD-82/7
FAA/RD-82/16	FAA/RD-82/24	FAA/RD-82/57
FAA/RD-82/78	FAA/PM-83/4	FAA/PM-83/32
FAA/CT-TN85/5	FAA/CT-TN85/17	FAA/PM-86/14
FAA/PM-86/15		

LORAN-C VERTICAL NAVIGATION (VNAV)

FAA/RD-82/16

LORAN FLIGHT FOLLOWING (LOFF)

FAA-RD-80-85 FAA-RD-80-87 FAA-RD-80-88 FAA-RD-81-55 FAA-RD-81-59 FAA/CT-TN86/17

LOW-ALTITUDE COMMUNICATIONS (See also Northeast Corridor)

FAA-RD-78-101 FAA-RD-78-150 FAA-RD-79-123 FAA-RD-80-20 FAA-RD-80-80 FAA-RD-80-87 FAA-RD-81-9 FAA/RD-81/40 FAA-RD-81-59 PM-85-2 LR FAA/PM-85/8

LOW-ALTITUDE NAVIGATION (See also LORAN-C, Northeast Contidor, and GPS)

FAA-RD- /1-96	FAA-RD-76-146	NA-78-55 LK
FAA-RD-78-101	FAA-RD-78-150	FAA-CT~80-18
FAA-RD-80-20	FAA-RD-80-80	FAA-RD-80-87
FAA-RD-81-59	FAA/PM-83/32	

LOW-ALTITUDE SURVEILLANCE (See also LOFF)

FAA-RD-78-150	FAA-RD-80-20	FAA-RD-80-80
FAA-RD-80-87	FAA-RD-81-59	

LOW SPEED APPROACHES

NA-68-21	FAA-RD-80-58	NAE-AN-26 (1985)
FAA/PM-86/14	FAA/PM-86/15	FAA/CT-TN86/31
NAE-AN-26 (1985)		

MLS FLIGHT INSPECTION (See Flight Inspection)

MICROWAVE LANDING SYSTEM (MLS), GENERAL (See also DME)

FAA-RD-78-101	FAA/RD-82/6	FAA/RD-82/40
FAA/CT-TN84/16	FAA/CT-TN84/20	FAA/CI-TN84/40
FAA/PM-85/7	FAA/CT-TN85/15	FAA/CT-TN85/53
FAA/CT-TN85/55	FAA/CT-TN85/58	FAA/CT-TN85/63
FAA/CT-TN85/64	FAA/CT-86/14	FAA/PM-86/14
FAA/PM-86/15	FAA /AVN-200/25	(1986)

MLS RNAV

FAA-RD-80-59	FAA/RD-82/40	FAA/PM-85/7
FAA /CT-TN85/63	FAA/PM-86/25. I	

MLS SITING

FAA/CT-TN84/40	FAA/CT-TN85/53	FAA/CT-85/58
FAA/CT-TN85/64		

MLS TERPS (See also TERPS)

FAA-RD-80-59	FAA-RD-81-167	FAA/CT-TN84/16
FAA/CT-TN84/20	FAA/CT-TN85/53	FAA/CT-TN85/55
FAA/CT-TN86/31	FAA/AVN-200-25 (1	986)

MILITARY TRAINING ROUTES

FAA-RD-80-88, I

NAVIGATION SATELLITE TIMING AND RANGING (NAVSTAR) (See GPS)

NEAR MID-AIR COLLISIONS (See also TCAS)

FAA-RD-80-88,I FAA/CT-83/40 FAA/PM-85/6

NOISE

FAA-RD-73-145	FAA-RD-75-79	FAA-RD-75-125
FAA-RD-75-190	FAA-RD-76-1	FAA-RD-76-49
FAA-RD-76-116	FAA-RD-77-57	FAA-RD-77-94
FAA-RD-78-101		

Note: During the late 1970's, responsibility for issues regarding helicopter noise was transfered to the FAA Office of Environment and Energy (AEE). The reports listed in this bibliography are limited to those in which the research, engineering, and development elements (i.e., the ADL complex) of the FAA have been involved as sponsors, participants, or authors. Since AEE is outside the ADL complex, the reports they have published on helicopter noise are not listed herein.

NONDIRECTIONAL BEACON

FAA-RD-76-146	FAA-RD-78-101	FAA-RD-78-150
FAA-RD-80-85	FAA/RD-82/6	FAA/PM-86/25,I

NONPRECISION APPROACHES (See also Airborne Radar Approaches)

NA-80-34-LR	FAA-CI-80-175	FAA-RD-81-27
FAA/RD-82/8	FAA/RD-82/9	FAA/RD-82/16
FAA/RD-82/71	FAA/RD-82/78	FAA/CT-82/103
FAA/CT-TN83/03	FAA/CT-TN84/34	FAA/CT-TN85/17
PAA/PM-86/25.I		

NORTHEAST CORRIDOR

FAA-RD-70-10	FAA-RD-80-17	NA-80-34-LR
FAA-RD-80-59	FAA-RD-80-80	FAA-CT-80-175
FAA-RD-81-59	FAA/CT-82/57	FAA/RD-82/78
FAA/CT-TN85/17		

OBSTRUCTION AVOIDANCE (See also Airborne Radar Approaches and TERPS)

FAA-RD 81-59	FAA-RD-80-107	FAA/PM-86/28
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OFFSHORE OPERATIONS (See also Gulf of Mexico and Airborne Radar Approaches)

FAA-RD-76-123	FAA-RD-76-146	NA-78-55-LR
FAA-KD-/6-123	FAA-KD-/0-140	MW-10-22-TW
FAA-RD-79-123	FAA-RD-80-20	NA-80-34-LR
FAA-RD-80-87	FAA-RD-80-107	FAA-RD-81-27
FAA-RD-81-55	FAA/RD-82/6	FAA/PM-83/4

OMEGA

NA-78-55-LR	FAA-RD-78-101	FAA-RO-78-150
FAA-RD-80-85	FAA-RD-80-88,II	FAA/RD-82/6
FAA /PM-86/14	FAA/PM-86/15	

PRECISION APPROACH RADAR (PAR)

FAA-RD-80-107

RNAV (See Area Navigation)

ROTOR BLADE CONTAINMENT

FAA-RD-77-100

SAFETY (While this topic is addressed in most of the documents in this bibliography, the following documents are of particular interest.)

FAA/CT-83/6	PM-85-2-LR	PM-85-3-LR
PM-85-4-LR	FAA/PM-85/6	FAA/PM-86/28
FAA/PM-86/45		

SIMULATION

NA-68-21	FAA-RD-79-59	FAA-RD-80-64
FAA-RD-80-86	FAA-RD-80-86	FAA-RD-80-88
FAA-RD-81-59	FAA/CT-85/11	FAA/PM-86/14
FAA/PM-86/15		

TACAN

FAA-RD-76-146	FAA-RD-78-101	FAA-RD-80-88,II
FAA/RD-82/6	FAA/RD-82/63	

TERMINAL INSTRUMENT PROCEDURES (TERPS)

FAA-RD-78-150	FAA-RD-80-17	FAA-RD-80-58
FAA-RD-80-59	FAA-RD-80-80	FAA-RD-80-107
FAA-CT-81-167	FAA/CT-TN84/16	FAA/CT-TN84/20
FAA/CT-TN85/15	FAA/CT-TN85/24	FAA/CT-TN85/53
FAA/CT-TN85/55	FAA/PM-86/14	FAA/PM-86/15
FAA/AVN-200-25 (1	986)	

TILT ROTOR

FAA-RD-78-150

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)

FAA/RD-82/63	FAA/CT-83/40	FAA/PM-85/6
FAA/PM-85/30	FAA/CT-TN85/49	FAA/CT-TN85/60
FAA/CT-TN85/83		

TRAINING

FAA-RD: 78-150	FAA-RD-80-88	FAA-RD-81-59
FAA/CT-83/6	FAA/CT-TN85/55	FAA/PM-86/28
PAA /DM-86/45	FAA /AVN- 200/25	(1986)

FAA/PM-86/45 FAA/AVN- 200/25 (1986

VERY LIGHT WEIGHT AIR TRAFFIC MANAGEMENT EQUIPMENT (VLATME)

FAA-RD-80-87

VOR

FAA-RD-71-96	FAA-RD-76-146	FAA-RD-78-101
FAA-RD-78-150	FAA-RD-80-17	NA-80-34-LR
FAA-RD-80-64	FAA-RD-80-85	FAA/RD-82/6
FAA/RD-82/78	FAA/CT-TN85/24	PAA/PM-86/14
PAA /DM-86/15	FAA /DM-86/25 T	

WAKE VORTEXES

RD-64-4	RD-64-55	FAA-RD-74-48
FAA-RD-78-143	FAA-RD-80-87	FAA-RD-80-88.II

WEATHER (See also Icing)

RD-64-4	FAA-RD-75-94	FAA-RD-78-101
FAA-RD-79-59	FAA-RD-79-64	FAA/RD-81/92
FAA/CT-83/6	FAA/PM-84/22	FAA/PM-84/25

WEATHER FORECASTS

FAA/RD-81/40	FAA-RD-81-92	FAA/PM-84/31
FAA/PM-86/10		

WEATHER OBSERVATIONS

FAA/RD-81/40	FAA/CT-TN85/23
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WIND SHEAR

FAA-RD-79-59

WORKLOAD

FAA-RD-78-157	FAA-RD-79-64	FAA-RD-79-99
FAA-RD-80-58	FAA-RD-81-59	FAA/CT-TN85/15
FAA/CT-TN85/55	FAA/CT-TN85/58	NAE-AN-26 (1985)
FAA/CT-TN86/31	FAA/AVN-200/25	(1986)

APPENDIX C: AUTHOR INDEX

ACE, RONALD E. (Systems Control Technology)

FAA/RD-82/6

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ADAMS, RICHARD J. (Systems Control Inc. (Vt), Systems Control Technology)

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FAA-CT-81-35

FAA/PM-85/6

FAA/PM-86/28

FAA/PM-86/45

ADAMS, JOHN Y. (FAA Technical Center)

FAA/CT-85/26

ANDREWS, JOHN W. (Lincoln Laboratory)

FAA/PM-85/30

BAUSCH, W. (Hamilton Standard, a Division of UTC)

FAA-RD-75-79

BENNETT, W.J. (Boeing Airplane Division)

RD-64-55

BILLMANN, BARRY R. (FAA Technical Center)

FAA/CT-83/40 PAA/CT-86/14

FAA/CT-TN85/17 FAA/CT-TN85/58

BLAKNEY, DENNIS F. (Lockheed-Georgia)

FAA-RD-73-145

FAA-RD-75-125

BOLUKBASI, AKIF O. (Simula Inc.)

FAA/CT-85/11

BOLZ, ERIC H. (Systems Control Technology)

FAA/RD-82/16

FAA/PM-85/8

BURNHAM, DAVID C. (Transportation System Center)

FAA-RD-78-143

CHAMBERS, HARRY W. (FAA Technical Center)

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CLEMENT, WARREN F. (Systems Technology)

FAA-RD-79-59

COLTMAN, JOSEPH W. (Simula Inc.)

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CONNOR, JEROME T. (FAA Technical Center)

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CONWAY, ROBERT C. (FAA, NAFEC)

NA-68-21

COYLE, JAMES J. (FAA, NAFEC)

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CROSWELL, THOMAS H. (RJO Enterprises)

FAA/PM-86/25

CUSHMAN, ARTHUR W. (FAA Technical Center)

FAA/CT-TN85/83

DADONE, L.U. (Boeing Vertol)

FAA-CT-80-210

DeLUCIEN. ALBERT G. (PACER Systems Inc.)

FAA-RD-78-157 FAA-RD-80-107 FAA-RD-79-64 FAA/RD-81/35 FAA-RD-80-58

DEVORE, GILBERT (FAA, NAFEC)

NA-67-1

DINERMAN, BERNHART V. (FAA, NAFEC)

FAA-RD-71-96

EDMONDS, JACK D. (FAA Technical Center)

FAA/CT-82/57

ENIAS, JAMES H. (FAA Technical Center)

FAA/CI-TN84/16

FAA/CT-TN84/20

FAA/CT-TN85/15

FAA/CI-TN85/55

FAA/CT-TN85/58

ERIKSSON, R.H. (Pratt & Whitney)

FAA-RD-77-100

ESPOSITO, ROBERT J. (FAA Technical Center)

FAA/RD-82/8

FAA/RD-82/9

FAA/RD-82/71

EVANS, JEAN (FAA Technical Center)

FAA/CT-TN86/17

FORREST, R.D. (NASA Ames Research Center)

FAA-RD-80-64

FREUND, D. JAMES (VITRO)

FAA-RD-80-85

FAA-RD-80-86

FAA-RD-80-87

FAA-RD-80-88

FAA-RD-81-59

GERDES, R.M. (NASA Ames Research Center)

FAA-RD-80-64

GIBSON, JOHN S. (Lockheed-Georgia)

FAA-RD-73-145

FAA-RD-75-125

GILBERT, GLEN A. (Helicopter Association of America, Helicopter Association International)

FAA-RD-80-80

FAA-RD-81-55

GREEN, DAVID L. (PACER Systems Inc.)

FAA-RD-78-157

FAA-RD-79-64

FAA-RD-80-58

GUINN, WILEY A. (Lockheed-Georgia)

FAA-RD-73-145

HALE, CHARLES (FAA, Oklahoma City)

FAA/AVN-200/25 (1986)

HALLOCK, JAMES (Transportation System Center)

FAA-KD-78-143

HANLEY, WILLIAM J. (PAA, NAFEC)

NA-67-1

HARRIGAN, JOSEPH (FAA, NAFEC)

FAA-RD-80-17

HEERMANN, K.F. (Pratt & Whitney)

FAA-RD-77-100

HIGGINS, THOMAS H. (FAA, Washington)

FAA-RD-76-1

HILSENROD, ARTHUR (FAA, Washington)

FAA/RD-81/40

JECK, RICHARD K. (Naval Research Laboratory)

FAA-RD-80-24 FAA/CT-83/21

JETER, ROBERT S. (FAA Technical Center)

FAA/CT-TN85/64

JEWELL, WAYNE F. (Systems Technology)

FAA-RD-79-59

JONES, PAUL H. (FAA Technical Center)

JORDAN, STEVEN W. (PACER Systems Inc.)

FAA/CT-82/120

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KERELIUK. STAN (National Aeronautical Establishment)

EAE-AN-26 (1985)

KING, LARRY D. (Systems Control Inc. (Vt), Systems Control Technology)

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FAA/CT-TN84/34 FAA/CT-TN86/22

FAA/PM-83/4

FAA-RD-83-32

FAA/PM-85/8

KING, R.J. (Hamilton Standard, a division of UTC)

FAA-RD-75-79

KOWALSKI, STANLEY (RJO Enterprises)

FAA/PM-86/25

LAANANEN, DAVID H. (Simula Inc.)

FAA/CT-85/11

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PAA/PM-84/23

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FAA-RD-80-64

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FAA-RD-77-57

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PAA/RD-82/71

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FAA-CT-80-175

FAA/RD-82/24 FAA/RD-82/78

FAA/CT-TN86/17

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FAA-RD-81-27

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FAA/CT-TN84/20 FAA/AVN-200/25

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FAA-RD-81-9

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MAGLIOZZI, B. (Hamilton Standard, a division of UTC)

FAA-RD-75-79 FAA-RD-76-49

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PAA-RD-77-100

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FAA-RD-81-92

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FAA/RD-82/40

FAA/PM-83/4

FAA/PM-83/32

FAA/PM-85/7

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FAA/RD-82/40

FAA/PM-84/22

FAA/PM-84/25

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FAA-RD-81-7-LR

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FAA-RD-78-143

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FAA-RD-75-79

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FAA/PM-84/31 FAA/PM-86/10

MORGAN, J. MURRAY (National Aeronautical Establishment)

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FAA/RD-82/7 FAA/CT-TN85/17

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PAA/CT-TN84/47

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FAA/CT-TN84/20 FAA/AVN-200/25 (1986)

PAPROCKI, THOMAS H. (FAA Technical Center)

NA-69-2

FAA~RD-72-133

PEREZ, JOSEPH (FAA, NAFEC)

FAA-RD-80-18

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PAA-CT-80-210

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FAA/PM-86/14 FAA/PM-86/15

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PAA-RD-81-7-LR

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FAA-RD-80-58

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FAA-RD-80-47 FAA-CT-81-167

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FAA-RD-70-10

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FAA/PM-86/15

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FAA-RD-78-143

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NA-69-2

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FAA/PM-85/6

FAA/PM-86/28

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FAA/CT-TN83/03

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FAA-RD-78-157

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FAA-RD-77-94

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FAA/PM-83/32

FAA/PM-85/7

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PAA-RD-80-85

FAA-RD-80-86

FAA-RD-80-87

FAA-RD-80-88

FAA-RD-81-55

FAA-RD-81-59

WALTER, FRED (Scientifico)

FAA-RD - 71-105

WARREN. JOHN (FAA Technical Center)

FAA/CT-TN85/83

WEBB. MICHAEL M. (FAA Technical Center)

FAA/CT-TN85/58

FAA/CT-TN86/31

WEISS, ROSANNE M. (FAA Technical Center)

FAA/CT-TN85/5 FAA/PM-86/30

WEST, THOMAS C. (FAA, Washington)

FAA-RD-79-59

WHITE, MICHAEL (ARINC Research)

FAA-RD-80-20

WINSTON, BERL (Transportation System Center)

FAA-RD-78-143

WITCZAK, MATTHEW W. (Univ. of Maryland)

FAA/PM-84/23

WOLF, CHRISTOPHER (FAA Technical Center)

FAA/CT-TN85/17 FAA/CT-TN85/24

APPENDIX D: ACRONYMS

ABC Advancing blade concept

ADF Automatic direction finder

AM Amplitude modulated

AMA Analytical Mechanics Associates

ARINC Aeronautical Radio Inc.

ATC Air traffic control

AWOS Automated weather observing system

AWOS GEM AWOS generalized equivalent markov

E-L Electroluminescent

Ems Emergency medical service

FAA Federal Aviation Administration

PAATC FAA Technical Center

FLIR Forward looking infared radar

GEM Generalized equivalent markov

GPS Global positioning system

HAA Helicopter Association of America

HAI Helicopter Association International

HF High frequency

IFR Instrument flight rules

ILS Instrument landing system

INS Inertial navigation system

WFF Loran flight following

MLS Microwave landing system

NAE National Aeronautical Establishment

NAFEC National Aviation Facilities Experimental

Center

NASA National Aeronautics and Space

Administration

NAVSTAR Navigation satellite timing and ranging

NRL Naval Research Laboratory

PAR Precision approach radar

RNAV Area navigation

SCF Systems Control Technology

STOL Short takeoff and landing

TCAS Traffic alert and collision avoidance

system

TERPS Terminal instrument procedures.

VFR Visual flight rules

VLATME Very light weight air traffic management

equipment

VNAV Vertical navigation

VOR Very high frequency omnidirectional radio

range

VTOL Vertical takeoff and landing

APPENDIX E: ABSTRACTS

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		Technical Report Decomeniation	· oge	
1. Report No.	2 Government Accession No.	3. Recipient's Catalog No.		
35-54-4	AD-436746			
4. Title and Subtitle	L	5. Report Date		
State-of-the-Art Curvey	or Minimum Approach, Land:	ng. January 1964		
and Takeoff Intervals as	Dictated by Wakes, Vortice	6. Performing Organization Code		
and Weather Phenomena	•	1		
7. Author(s)		8. Performing Organization Report No.		
W. J. Bennett		İ		
9. Performing Organization Name and Address		10. Work Unit No. (TRAIS)		
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Boeing Airplane Division		11. Contract or Grant No.		
Renton, Washington		FA-WA-4450		
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12. Sponsoring Agency Name and Address		Phase I		
Federal Aviation Administ		Final Report		
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15. Supplementary Notes				
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16. Abstract			ı	
analysis is presented for wake movement with time a propulsion system is analywell as for pure propulsion	nd effect, and its effect both fixed- and rotarywin and the wake-induced velocities both for normal operation lift. The influence of	tion and reversed thrust, as		
well as for pure propulsion lift. The influence of atmospheric parameters such as wind, temperature, and turbulence is discussed as it applies to the generation and decay of the wake.				
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17. Key Words	18. Distribution Ste	tement		
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Aircraft Separations	mation Ser	vice, Springfield, Virginia		
Air Traffic Control	22161			
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RD-64-55	AD-607251	
	ation of the Velocity Fields i	5. Report Date in May 1964
the Wakes of Specif	ied Aircraft	6. Performing Organization Code
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Performing Organization Name of Boeing Airplane Div		10. Work Unit No (TRAIS)
Renton, Washington	13.01	11. Contract or Grant No. FA-WA-4450
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Federal Aviation Ad		Phase II
	d Development Service	Final Report
Washington, D.C.		14. Sponsoring Agency Code
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velocity fields in material presented one part of a large	ts Phase II of a two-part stud the wakes of fixed-wing and ro in this report, together with program directed toward deter ircraft operating in the air t	tary-wing aircraft. The that in RD-64-4, comprises mining safe separation times
are analyzed. Nume	ft currently operating within rical data are presented in taaft, defining their respective	the Air Traffic Control system bular and curve form for wake velocity fields.

 Λ discussion of the assumptions and limitations of the analytical models used

is included along with a discussion of possible correlation of the calculated values with test results.

17.	Key Words		18. Distribution States	nent	
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1. Report No.	2. Government Accession No.	3. F	Recipient's Catalog N	lo.	
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4. Title and Subtitle An Analysis of the Helicopter Height Velocity			leport Date		
Diagram including a Practi		I F	February 1968 Performing Organizati	Code	
Determination			errorming Organizati	on Code	
		8. P	erforming Organizati	an Report No.	
7. Author(s) William J. Hanley Gilber	t DeVore	7	MA-67-1 (DS-6	(7_23)	
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test data obtained from the rotor helicopters of varyi	-	_		_	
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the effects of aircraft we	ight and altitude or	the H-V di	agram. Anal	ysis	
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and the solution of specif An evaluation of the H-V d					
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power failure. A suggests					
diagrams is also presented					
17. Key Words 18. Distribution Statement Belicopter Document is on file at the			C41 44 43	NI A EVEVO	
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Height Velocity Diagram Autorotation 1 dibrary 28405			iic ordy, new	octocy	
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15	Supplementary Notes				
16	Abstract				
	A simulation study was conducted to determine the effect on air traffic control when both Vertical and Short Takeoff and Landing (VTOL and STOL) aircraft are introduced into a terminal air traffic control environment. It was uncluded that VTOL and STOL aircraft could be accommodated in the terminal air area using present operational procedures as contained in the Terminal Air Traffic Control Manual 7110.8. However, when VTOL and STOL aircraft reduced from terminal area speed to a slow final approach speed, difficulties were one entered in providing not only the desired spacing between these aircraft be between these aircraft and conventional aircraft in the sequence to and on the final approach course. It was recommensed that, in the planning of future VTOL and STOL aircraft ports consideration be given to the location and runway alignment in order that the traffic fix wiff this slopent be compatible with that of other traffic. It was also recommensed that dishi tests be conducted under simulated Instrument Flightle conditions to be examine the most favorable relationship between glide slop angle, rate of necessary and approach speed for both Vertical and Short Takeoff and Januing aircraft. It was further recommended that the feasibility of non-coangard separation be examined in a live environment.				
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1. Report No. NA-69-2	2. Government Accession No.	3. Recipient's Cutolog No.
4. Title and Subtitle Flight Test and Evaluation of Heliport Lighting for VFR		5. Report Date March 1969 6. Performing Organization Code
7. Author's) Richard Sulzer, Thomas F	-	8. Performing Organization Report No. NA-69-2 (RD-68-61)
9. Performing Organization Name and Address Federal Aviation Administration National Aviation Facilities Experimental Center Atlantic City, New Jersey 08405		10. Work Unit No. (TRAIS) 11. Contract or Grant No.
12. Sponsoring Agency Name and Address Federal Aviation Administration National Aviation Facilities Experimental Center Atlantic City, New Jersey 08405		13. Type of Report and Period Covered Final Report 14. Sponsoring Agency Code
15 Supplementary Notes		

16. Abstract

The guidance value of heliport lighting system components was tested under VFR conditions in a joint FAA/U.S. Army effort. The overall system included lighting to identify and locate the heliport and support the approach and landing of helicopters.

Forty-six civil and military pilots flew on 11 nights at Tipton Army Airfield, Fort Meade, Maryland, producing the following conclusions: The heliport beacon, flashing green-yellow-white, had adequate range and distinctiveness but could be improved by a change in flash rate; the yellow pad perimeter lighting met all requirements; the white approach direction and yellow landing direction lighting components were satisfactory; both pad surface floodlighting and pad insert lights were used satisfactorily, and all pilots who were shown the painted maltese cross marking rated it as an aid at night; the lighted wind sock provided adequate wind direction information if overflown first, but neigher the lighted wind sock nor the lighted wind tee tested were adequate to provide this information to a pilot on the approach path at one-half mile from the pad.

A minimum VFR heliport lighting system is recommended to include the beacon for location information, the perimeter lights and painted marking for pad identification, and the lighted wind sock to provide wind information. Other components are recommended for installation when required by special conditions.

17. Key Words Heliport Lighting Heliport Beacon Heliport Marking	ſ	file at the NAFEC tic City, New Jersey
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1. Report No.	2. Government Acce	ssion No.	3. Recipient's Catalog No.	
FAA-RD-70-10	AD-705507			
4. Title and Subtitle			5. Report Date	
EVALUATION OF L	ORAN-C/D AIRB	ORNE	April 1970	
SYSTEMS -			6. Performing Organization Code	
7. Author(s)			8. Performing Organization Report No.	
George H. Quinn			FAA-NA-70-7	
9. Performing Organization Name and FEDERAL AVIATION		ON.	10. Work Unit No.	
National Aviation Fac	ilities Experimen	ntal Center	11. Contract or Grant No.	
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17. Key Words Loran-C		18. Distribution Ste	stement	
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TECHNICAL	REPORT	STANDARD	TITLE PAGE

1. Report No.	2. Government Accession No.	3 Recipient's Catalog No
FAA-RD-71-96	AD=735399	
4. Title and Sultitle ANALYTICAL STUDY OF	THE ADL; JACY OF VOR/DME	5. Report Date December 1971
AND DME/DME GUIDANC NAVIGATION IN THE L	E SIGNALS FOR V/STOL AREA OS ANGELES AREA	6. Performing Organization Code
7. Author's)		8. Performing Organization Report No
Bernhart V. Dinerma	n	FAA-NA-71-45
9. Performing Organization Name and Address		10. Work Unit No.
National Aviation F	acilities	
Experimental Cente:	r	11. Contract of Grant N (330-014-04%)
Atlantic City, New o	Jersey 08405	Project No. 045-390-01X
		13. Type of Report and Period Covered
12 Sponsoring Agency Name and Add FEDERAL AVIATION ADM	1INISTRATION	Interim Report
Systems Research and Development Service		July 1970 - June 1971
Washington, D. C.	20 59 1	14. Sponsoring Agency Code
15 Supelanatary Notes		

An analysis was performed by personnel of the National Aviation Facilities Experimental Center (NAFEC) to determine the adequacy of very high frequency omnirange/distance measuring equipment (VOR/DME) guidance signals for vertical/short takeoff and landing (V/STOL) aircraft area navigation (RNAV) in the Los Angeles (LAX) area. Guidance signals were derived from existing VOR/DME and "converted" VOR facilities. It was concluded that: (1) VOR/DME RNAV over seven approved routes was feasible when using the existing VOR/DME facilities; (2) DME/DME RNAV over the approved routes is feasible when using station-pair combinations from existing VOR/DME facilities and certain converted VOR stations; (3) Except for the last segment of the LAX to Van Nuys (VNY) direct route, VOR/DME RNAV over the hypothetical direct routes was feasible when using existing VOR/DME facilities; (4) Except for the last segment of the LAX to VNY direct route, DME/DME RNAV over the direct routes was feasible when using station-pair combinations from existing VOR/DME facilities and certain converted VOR stations; (5) RNAV using DME/DME was potentially more accurate than VOR/DME; and (6) The number of en route station changeovers for VOR/DME and DME/DME RNAV over the approved and direct routes was considered acceptable.

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1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.	
FAA-RD-71-105	AD-745574		
4. Yitle and Subritle HELIPORT BEACON DESIGN,	5. Report Date December 1971		
TESTING	and the same of th		
7. Author/s)		8. Performing Organization Report No.	
Fred Walter			
9. Performing Organization Name and Address		10. Work Unit No.	
SCIENTIFICO	074-390-013		
Scientific Components C	ompany	11. Contract or Grant No.	
Newport Beach, Californ	ia 92660	FA70WA-2340	
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Department of Transportation Federal Aviation Administration Systems Research and Development Service Washington, D. C. 20591		Final Report	
		14. Spansaring Agency Code	
15. Supplementary Notes			

16. Abstract

A heliport beacon production prototype was designed, constructed, and tested for optical performance and resistance to environmental conditions. The revolving beam beacon employs two 250 W, 130 V tungsten-halogen lamps, one each for the aviation green and aviation yellow projectors, and one 500 W, 120 V tungsten-halogen lamp for the white split beam projector. Lamp life is in excess of 5,000 hours at 115 V except with the 500 W lamp of the white beam projector, for which no 5,000 lamp has yet been found. The life of this lamp is approximately 3500 hours. The entire beacon system is sealed against the environment. The complete device weighs less than 50 pounds and can be mounted on standard light poles. It is about 16" in diameter and 24" tall. Low weight and cost are accompanied by low power consumption and minimal maintenance requirements, reducing the costs for installation and operation to a fraction of the amounts heretofore associated with devices of this kind.

Beacons Heliport Helicopter Heliport Beacons Rotating Beacons	-	18. Distribution Statement Availability is a be released to the Information Servi Virginia 22151, i	ne National I ce, Springfi	echnical
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1. Report No.	2. Government Accession N	3. Recipient's Catalog No.	
FAA-RD-72-133	AD-753058		
4. Title and Subtitle FLIGHT TEST AND EVALUATION		5. Report Date December 1972	
LIGHTING FOR IFR		6. Performing Organization Code	
7. Author's) Thomas H. Paprocki			
9. Performing Organization Name and A		10. Work Unit No.	
National Aviation Fac Experimental Center		11. Contract or Grant No.	
Atlantic City, New Je		Project 074-390-02X	
12 Spansoring Agency Name and Addre		13. Type of Report and Pariod Covered Final	
FEDERAL AVIATION ADMI Systems Research and	INISTRATION	March 1969 - October 1972	
Washington, D. C. 20		14. Sponsoring Agency Code	
flight testing effort providing visual guid Four basic lighting d ditions, by experience	ts, were evaluated to dance for helicopter configurations were f ced helicopter subject	developed through mockup and VFR determine their effectiveness in IFR approach and landing operations. lown, under actual IFR weather conts pilots. As a result of information.	
completion of pilot of		g of objective data and post flight f the lighting patterns was chosen ified.	
'7. Key Words Heliport Lighting Helicopter Guidance Visual Aids	Avai be i Info	lability is unlimited. Document may released to the National Technical ormation Service, Springfield, Virginia il, for sale to the public.	
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1. Report No. PAA-RD-73-47	2. Government Accession No.	3. Recipient's Catalog No.
1nn-nu-13-41	AD-759864	
4. Title and Subtitle		5. Repart Date
ATC CONCEPTS FO	R V/STOL VEHICLES	April 1973
PARTS	1 AND 2	6. Performing Organization Code
		8. Performing Organization Report No
7. Author(s) Sidney B. Rossite Paul J.	r, John Maurer, and O'Brien	FAA-NA-72-95
9. Performing Organization Name and Ad	dress	10. Work Unit No. (TRAIS)
Federal Aviation Adminis	tration	L
National Aviation Facili		11. Contract or Grant No.
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Department of Transporta	tion	March 1971 - August 1972
Federal Aviation Adminis	tration	
Systems Research and Dev	elopment Service	14. Sponsoring Agency Code
Washington, D.C. 20591	-	
15. Supplementary Notes	······································	

Landing (STOL) aircraft traffic sample inputs, to study the effects of various aspects of STOL aircraft operations within the Air Traffic Control System. One investigated the effects of STOL aircraft operating at a downtown STOLport within the New York terminal area complex; the other investigated the effect of STOL aircraft operating on various configurations of STOL runways at a high-density, multirunway, conventional takeoff and landing (CTOL) airport. It was concluded that STOL operations can be accommodated at a downtown STOLport; however, where airspace is limited, intricate profiles requiring a high degree of aircraft performance may be required. The performance of these profiles should be an onboard responsibility

limited, intricate profiles requiring a high degree of aircraft performance may be required. The performance of these profiles should be an onboard responsibility using highly accurate area navigation equipments with the ATC facility serving as a monitor. The current method of controller speed commands can be used as an interim method of metering and spacing pending more sophisticated methods, but requires flexible aircraft speed parameters and close cooperation between pilot and controller. As an aid to airspace utilization, a glide slope of 7 1/2° is beneficial and may be essential. It was further concluded that the least effect on CTOL operations at a CTOL/STOL airport is achieved by a parallel system of STOL runways bordering upon the CTOL complex. The techniques for controlling STOL aircraft at a CTOL

airport are similar to those applied to CTOL aircraft; however, more emphasis is placed on speed control as opposed to radar vectoring because of the criticalness of the operation within the confines of limited airspace. A steep glide slope, preplanned pilot-performed flight tracks, and the limiting of the number of STOL routes into the terminal area are aids to an efficient STOL operation.

17. Key Words STOL Terminal ATC	through the Nat	Document is available to the public through the National Technical Information Service, Springfield, Virginia 22151		
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TECHNICAL REPORT STANDARD TITLE PAGE

PAA-RD-73-145 AD-774794 Title and Substite V/STOL NOISE PREDICTION AND REDUCTION August 1973 Performing Organization Code W. A. Guinn, D. F. Blakney, J. S. Gibson Performing Organization Report No. LOCKHEED-GEORGIA COMPANY Morietto, Georgia DOT-FA72WA-3099 13 Separating Agency Name and Address DEPAPTMENT OF TRANSPORTATION Federal Aviation Administration Systems Research & Development Service Washington, D. C. 20590 3 Separating Agency Code Washington, D. C. 20590 A four Phase program is described. Phase I was concerned with the identification of noise sources in rotary and jet stream type propulsion systems for V/STOL aircraft. In order to facilitate the noise source identifications and previde needed data for subsequent work, an extensive bibliography (309 references) was compiled. Phase II work covers the definition of noise generating mechanisms for jet stream V/STOL systems. Phase III discusses the noise reduction concepts which are applicable. In Phase IV, hand calculation and computer programs are derived and presented for predicting the for field noise environment of various types of V/STOL aircraft. B. Dismissional Separation Sepa	1. Resert No.	2. Government Age	naine Ma	Recipiont's Catalog	<u> </u>
4. First and Subtrite V/STOL NOISE PREDICTION AND REDUCTION 7. Author(s) W. A. Guinn, D. F. Blakney, J. S. Gibson W. A. Guinn, D. F. Blakney, J. S. Gibson W. A. Guinn, D. F. Blakney, J. S. Gibson W. A. Guinn, D. F. Blakney, J. S. Gibson W. A. Guinn, D. F. Blakney, J. S. Gibson UCCKHEED-GEORGIA COMPANY Marietta, Georgia 12. Sumering Agency Means and Address DEPAPTMENT OF TRANSPORTATION Federal Aviation Administration Systems Research & Development Service Washington, D.C. 20530 13. Supelementery Means Prediction techniques apply primarily to V/STOL aircraft with jet stream augmented lift systems. 14. Abuset A four Phase program is described. Phase I was concerned with the identification of noise sources in rotary and jet stream type propulsion systems for V/STOL aircraft. In order to facilitate the noise source identifications and provide needed data for subsequent work, on extensive bibliography (809 references) was compiled. Phase II work covers the definition of noise generating mechanisms for jet, stream V/STOL systems. Phase III discusses the noise reduction concepts which are applicable. In Phase IV, hand calculation and computer programs are derived and presented for predicting the far field noise environment of various types of V/STOL aircraft. 17. Key Waste Acoustics, Noise Prediction, Aircraft Noise, Noise Reduction, V/STCL Noise, Aerodynamic Noise 18. Disminutes Statement Document is available to the public through the National Technical Information Service, Springfield, Virginia 22151 18. Septiming Organization Report No. 19. Septiming Organization Report 19. Performing Organization Report 10. Performing Organization Report 11. Generative of General Report 12. Septiming Organization Report 13. Supplementary of General Report 14. Septiming Organization Report 15. Performing Organization Report 16. Performing Organization Report 17. Septiming Organization Report 18. Disminute Septiming Organization 19. Septiming Organization 19. Septiming Organization Report 10. Septiming Organiza					•••
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16. Abstract			
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V/STOL Aircraft Noise	6. Performing Organization Code				
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H. N. Reddy, D. F. Blakney,	J. G. Tibbets, J	. S. Gibson	LG75ER0054		
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16. Abstract					
report the noise levels may also be estimated with hand calculations. Vectored thrust, externally blown flap, upper surface blown flap, internally blown flap, and augmentor wing are the propulsive-lift concepts considered. Semi-empirical equations are derived using the test results and theories for the following aircraft noise sources: Internal engine, jet, excess (core engine), high-lift system, airframe, and auxiliary power unit. The computer program predicts the perceived noise levels and tone corrected perceived noise levels for V/STOL aircraft at any specified sideline distance for known geometrical and operational parameters. This report supersedes the earlier report No. FAA-RD-73-145, August 1973.					
17 Key Bords		18. Distribution Stat			
Aircraft noise prediction V/STOL noise, noise contractor aerodynamic noise.	V/STOL noise, noise control, through the		available to the public N.T.I.S., Springfield		
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16. Abstract

Although this first phase of a two-phase program emphasized the extent that Perceived Noise Level in PNdB, Perceived Level in dBA, and corrections to these engineering calculation procedures reflected annoyance to next generation STOL aircraft noise signatures, other aspects of certification implementation were also considered and will be emphasized in a report on the second phase of the program.

As a means of determining the accuracy and reliability of engineering calculation procedures that could be utilized as a basis for noise certification of V/STOL commercial aircraft, 36 persons made annoyance judgments to 34 noise signals presented at 5 different levels. The signals included recordings of conventional jet aircraft operations, turboprop and reciprocating engine powered commercial aircraft, helicopter flybys, and simulations of V/STOL operations. Both relative annoyance and absolute acceptability judgments were obtained. Some of the results are:

- For flyover (not hover) operations EPNdB validly and reliably predicts annoyance.
- For hover type of operations EPNdB under predicts annoyance.
- When applied to all aircraft types, the FAR-36 tone correction degrades reliability for both PNdB and dBA while the duration correction improves reliability to a significant extent.
- A difference between calculated and judged values should be equal-to-or-greaterthan 3 EPNdB in order to conclude that the difference is reliable.

17. Key Werds	18.	Distribution Statement		
V/STOL Certification Aircraft Noise Annoyance to Noise	>	Document is averaged through Nation Service, Spring	al Technical	Information
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FAA-RD-76-1	AD-A035671	
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HUMAN RESPONSE TO SOUND: T LEVEL, PLAB (NOISINESS OR L	HE CALCULATION OF PERCEIVED OUDNESS) DIRECTLY FROM	6. Performing Organization Code 202-553~001
PHYSICAL MEASURES		8. Performing Organization Report No
7. Author's) THOMAS H. HIGGINS		
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Washington, D.C. 20590		202-553-001

15. Supplementary Notes

16 Abserved The relationship between the perceived level, PLdB, of sound (loudness or noisiness) is shown to be a function of the sound pressure squared and the sound frequency squared, i.e. PLdB = $k p^2 f^2$. A logarithmic formula employing this basic relationship between perceived level and pressure and frequency has been developed and is found to be as accurate as the more complex methods currently in use, i.e. PLdB = $14 + 20 \log_{10} P (ME) + 20 \log_{10} f (Hz)$ which is equal to the following: PLdB = $P(dB) - 60 + 20 \log_{10} F (Hz)$. The perceived level of an aircraft takeoff or landing is demonstrated to be equal, to the logarithmic sum of the perceived levels calculated using the above formula, for each octave band or 1/3 octave band, i.e. $PLdB = 10 \log_{10} [antilog_{10} PLdB_1/10 + antilog_{10} PLdB_2/10 + antilog_{10} PLdB_N/10]$

The results are found to be more accurate than the complex methods currently in use for the useful range of sound pressure levels and frequencies found to be associated with operational aircraft including helicopters, turbofan, turboprop and turbojet powered aircraft. This work, therefore, provides the systems engineer an easily understood and useful design and evaluation method. The formula developed clearly shows the design engineer and management personnel the relationship between the physical characteristics of an evolving system and its potential impact on human and community response.

17. Key Words Sound Perceived Level Human Response Engineering Calculation Proce Physical Measures	edure	18. Distribution Statement Document is ava through the Nat Information Ser Virginia 22151	ional Techni vice, Spring	cal
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V/STOL ROTARY PROPULSION SYSTEMS - MOISE				
PREDICTION AND RIDUCTION			May 1976	
Volume I - Identification	of Sources, Moise	Generating	Performing Organiza	iion Code
Machanisms, Noise Reduction	n Mechanisms, and	Prediction		
Methodology		h ,	. Performing Organize	tion Report No
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16. Abstract				
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			he defined se c	ombinations of
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A computer program is presented which allows a user to make performance and far-field acoustic moise predictions for free-air propellers, variable pitch fans with inlet guide vanes, variable pitch fans with outlet guide vanes, fixed pitch fans, helicopter rotors, tilt rotors, fixed pitch lift vames with remote, integral, and tip-turbine drives, and variable pitch lift fans with remote and integral drives. Noise prediction methodology for drive engines, single stream and coexial jets, and gearboxes are also included, as well as noise reduction and performance losses of partly somic inlets and duct acoustic treatment.

A description of the program, detailed instructions for its use, required inputs, and sample cases are presented.

Related documents include Volume I - Identification of Sources, Moise Generating Mechanisms, Hoise Reduction Mechanisms, and Prediction Methodology and Volume II - Graphical Prediction Methods.

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The test procedure for each helicopter consisted of obtaining noise data during hover, level flyover, and approach conditions. The data presented in this report consists of time histories, 1/3-octave band spectra, EPNL, PNL, dBA, dBD and OASPL noise levels.

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The tested helicopters can be grouped into classes depending upon where the maximum noise occurs during a level flyover. Helicopters with the higher main rotor tip speeds propagate highly impulsive noise ahead of the helicopter. The maximum noise for most of the helicopters occurs near the overhead position and appears to originate from the tail rotor. Unmuffled reciprocating engine helicopters appear to have significant engine noise behind the helicopter. Noise levels, when compared as a function of gross weight and flown at airspeeds to minimize "compressibility slap" form a band 7 EPNdB wide with a slope directly proportional to gross weight. The quieter helicopters have multibladed rotors and tipspeeds below 700 fps. The duration correction in EPNL is important in evaluating helicopter noise because it penalizes the longer time histories of the helicopters with significant blade slap during a level flyover.				
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16 Abstract

An engineering study on a large turbofan engine was conducted to: (1) accurately estimate the engine weight increase and design criteria necessary to contain equivalent disk fragments resulting from a rotor failure, (2) evaluate forward containment for tip fragments of fan blades, (3) identify critical structural components and loads for the loss of an equivalent fan disk fragment through analysis of the rotor/frame transient dynamic response. The fragments studied for engine containment were disk fragments with energy equivalent to two adjacent blades and an included disk serration, and four adjacent blades and three included disk serrations. The forward containment study was made to determine the additional weight required to contain or deflect turbofan engine fan blade tip fragments up to 30 degrees forward of the plane of rotation, as measured from the axis of rotation.

The results of this study indicated significant weight increases for the engine in order to contain the equivalent disk fragments of two blades with an included disk serration and four blades with three included disk serrations. The total resultant engine weight increase (shown in Table 9) for the two blade fragment is 367 pounds and for the four blade fragment is 682 pounds.

17. Key words Turbofan engine, containment, disk fragmeblade fragment, transient dynamic respons	•	through the N	vailable to thational Techniervice, Spring	
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AIRCRAFT WAKE VORTEX TAKEOFF TESTS AT TORONTO INTERNATIONAL AIRPORT		6. Performing Organization Code DTS-521		
7. Author's) T. Sullivan, J. Hallock, B. Winston, I. McWilliams, D. Burnham		8. Performing Organization Report No. DOT-TSC-FAA-79-9		
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16. Abstract

This report describes the collection and analysis of data related to the behavior of the wake vortices of departing aircraft. The test site was located on the departure end of Runway 23L at Toronto International Airport, Toronto, Ontario, Canada. Three arrays of Ground Wind Vortex Sensing Systems and one Monostatic Acoustic Vortex Sensing System were used to detect, track and measure the strength of the vortices.

The data were analyzed to determine vortex lifetimes, transport characteristics and decay mechanism.

The results of the data analysis were used to generate an elliptical wind rose criterion similar to that used in the Vortex Advisory System for reduction in interarrival aircraft spacings.

Appendix A contains the results of a series of measurements on the Vortices generated by a Boeing Vertol 114 (H47 Chinook) helicopter.

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800 Independence Avenue, S.W Washington, D.C. 20591		14. Spensoring Agency Code ARD-706
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16. Abatract

The problems which inhibit the integration of IFR operations in the ATC system were examined, and recommendations were made to resolve these problems. Revisions in TERPS criteria and in the ATC Handbook are necessary, to minimize interference between fixed-wing and rotary-wing aircraft. The use of 2 nm radar separation between IFR helicopters in terminal areas is recommended to increase capacity by reducing the time interval between helicopter approaches to a value consistent with the time interval between fixed-wing approaches. Helicopters have a special need for low-altitude RNAV capability and the ATC system needs to be better adapted to handle the random route traffic that helicopters will generate in exploiting their special capabilities. To this end, it is recommended that the FAA develop software to call up and display, on the ATC PPI, random waypoints and connecting routes, on an as-needed basis.

Helicopters operating offshore and in remote areas are often beyond the coverage of surveillance radar, thus requiring the use of procedural control. They also operate below the coverage of VHF communications and VOR/DME, requiring alternate types of systems, several of which are recommended. The need for special controller training in procedural control, and in helicopter characteristics and limitations was made apparent during the study.

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Certification of Helicopters for Instrument Flight Rules (IFR) Operation		6. Performing Organization Code SSED/ESD		
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15 Supplementary Notes

This report reviews the Airworthiness Standards for Certification of Helicopters for Instrument Flight Rules Operation. It specifically reviews the Interim Criteria, Federal Aviation Regulations, Advisory Circulars and other pertinent documents associated with the certification of Helicopters for Instrument Flight. A review of current technology, existing data applicable to IFR helicopter operation and certification procedures is accomplished. Identification of specific airworthiness requirements for helicoptors operating in IFR conditions is studied and special attention is given to aircrew manning configurations, pilot flightcontrol workloads, helicopter trim, static stability, dynamic stability, handling qualities, analysis of time history data and documentation procedures, augmentation systems, autopilots and a review of certain flight test techniques. An analysis was made of the numerous helicopters recently certified for IFR flight in order to establish the various systems utilized including avionics systems, display systems and autopilot type systems. Special emphasis was centered on the study of the most critical IFR flight phases depicted by high workload cruise conditions and marginal stability conditions due aft c.g. conditions, descent, and high climb rate conditions during IFR approaches and missed approaches for Category I procedures.

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PRESENCE OF NATURALLY-OCC GENERATED ATMOSPHERIC DIS	6. Performing Organization Code		
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Author's) Wayne F. Jewell, Warren F. Clement LCOL Thomas C. West, USA (Ret.), Dr. S.R.M. Sinclair		STI-TR-1099-3	
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15. Supplementary Notes

16. Abstract

The results of a two-phased program to investigate powered-lift aircraft handling quality degradation due to both naturally-occurring and computer-generated atmospheric turbulence are presented and discussed. In Phase I an airborne simulator was used to simulate a powered-lift aircraft on final approach. The atmospheric conditions included calm air, moderate to heavy turbulence, and frontal-type wind shears. In Phase II a ground-based simulator with a moving cockpit and a colored visual display was used to represent the same powered-lift aircraft. During Phase II, the Dryden model of atmospheric turbulence was used as well as the naturally-occurring wind profiles recorded during Phase I.

Analysis of the data showed that the handling quality assessments obtained in the airborne and ground-based simulators were similar, but wind shear was responsible for more of the differences than turbulence. The comparison of the handling quality assessments and selected measures of combined pilot-vehicle performance obtained with the naturally-occurring and computer-generated turbulences demonstrate that the Dryden model can yield optimistic ratings of airplane handling qualities and an optimistic estimate of combined pilot-vehicle performance degradation in turbulent landing conditions.

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This work was accomplished under modification No. 2 (effective date July 18, 1978; requisition/purchase request No. LGR-8-5518) of contract No. DOT-FA77WA-3966

A review was made of the Interim Criteria, Federal Aviation Regulations, Advisory Circulars and other pertinent Documents associated with certification of Helicopters for instrument flight. A review of publications pertaining to workload definitions and evaluation, applicable to IFR helicopter operations was accomplished. The report identifies the role of aircrew workload in the IFR certification process and develops a rationale to allow determination of that portion of a pilot's attention and effort available for aircraft control. Performance objectives for required maneuvers are delineated and the interdependence of performance and workload is identified. Workload/performance implications for single and dual pilot IFR operations are reviewed. A series of flight maneuver patterns for use as IFR certification assessment tools is developed. A flying qualities workload evaluation scheme is offered for use in the FAA certification process for IFR approval of helicopters.

HELICOPTER: PILOT WORKLOAD, IFR HANDLING QUALITIES, FAA CERTIFICA- TION FOR IFR OPERATIONS.		This document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161		National rvice,
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 Author's) Larry D. King and Richar 	d J. Adams		
 Performing Organization Name and Address Systems Control, Inc. (Vt) 1801 Page Mill Road Palo Alto, California 94304 		10. Wark Unit No. (TRAIS)	
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16. Abstract

This report presents the results of a comprehensive flight test experiment of an Airbotne Radar Approach (ARA) system. The tests were performed within a 60 nautical mile radius of NAFEC in Atlantic City, N.J. The test environment involved three distinct sites: airport, remote and offshore. The test aircraft was a NASA CH53A helicopter manufactured by Sikorsky Aircraft and currently based at NAFEC. The test period was from July 1978 to December 1978. Flight tests for ARA accuracy and procedures development were performed in both skin paint (and passive reflector) and single beacon radar operating modes. The flight test profiles and procedures were developed for the following reasons: 1) to assist the FAA and the user community in developing and certifying standard ARA procedures, associated weather minimums and obstacle clearance requirements; 2) to define and quantify specific ARA system functions and characteristics for use in a Minimum Operational Performance Standards (MOPS) document.

Champlain Technology Industries, A Division of Systems Control, Inc. (Vt)

A Subsidiary of Systems Control, Palo Alto, California

The primary conclusions of this flight test experiment were: the Airborne Radar Approach System tested performed satisfactorily from both an accuracy and an operational viewpoint in the single beacon mode for all three airspace environments; the ARA performance in the skin paint mode showed two significant problems, 1) distinguishing landside targets was quite difficult and could cause operational problems, 2) offshore targets such as oil rigs provide bright returns but are not distinguishable from boats, lighthouses and buoys; the ARA performance in the reflector mode showed that very large reflector cross sections are required to provide positive target identification.

Further flight experiments are planned to evaluate additional radar operating modes such as combined skin paint and beacon modes, and techniques of cockpit display to aid the pilot in his "track keeping" function.

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(NEC). The Northeast Corrido	or is an expen	imental route betw	een Boston a	nd
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16. Abstract This report presents pr	eliminary results of a flight used as an aid in acquiring a	test evaluation of a radar
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16. Abstract				
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A flight test series investi	gating the ai	rborne radar appro-	ach (ARA) for	r helicopters
is discussed. Passive and a	ctive target	enhancement method	s and their	relative
merits are examined. A desc	ription of sy	stems and methods:	involved in t	the ARA
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16 Abstruct

A limited amount of new data has been obtained on the icing environment during initial airborne measurements aimed at developing environmental icing criteria for use in certifying helicopters for flight into icing conditions. Supercooled cloud characteristics are reported for 12 icing events encountered at temperatures from -10°C to 0°C at altitudes from 3500 to 6500 ft above the surface of Lake Erie and Lake Michigan. Recorded droplet size spectra from a Particle Measuring Systems' Axially Scattering Probe (ASSP) were used to compute droplet mass (volume) median diameter (MMD) and, in addition to a Johnson-Williams LWC Indicator, the liquid water content (LWC). A review of available historical data from 1944-1950, upon which the atmospheric icing standards of Appendix C, FAR 25 were based, reveals that data obtained from measurements of ice accretion on multidiameter cylinders are subject to a number of significant errors of both These probable errors, which will continue to be evaluated, may be responsible for the conclusions that 1) the historical LWC values are generally larger than those observed in the flights described in this report, 2) the historical MMDs appear to be generally too small for all values of LWC and 3) the historical droplet size distributions are unreliable, as is acknowledged in the later historical literature.

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16. Abatroct

The Helicopter TERPS Development Program is designed to collate and coordinate all inputs received from government-sponsored and other projects which relate to helicopter TERPS in order to: assure that data generated by each project is developed, coordinated and applied in such a way as to avoid duplication of effort while achieving results in minimum time. It describes a development program whose objective is to develop criteria which will maximize the efficiency of terminal area and enroute operations with helicopters, by applying the unique maneuver-performance capabilities of helicopters. It includes both a near-term and long-term review of TERPS, both of which are expected to generate modification of the U.S. Standard for Terminal and Enroute Instrument Procedures and the criteria and procedures contained therein. The FAA, other Federal Government agencies, and organizations participating in this effort are identified. Program management responsibilities are addressed and a program schedule with milestones is presented.

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Champlain Technology Indus			itrol, Inc. ((Vt)
A subsidiary of Systems C	ontrol, Palo	Alto, California		
This comprehensive report presents the results of a flight test of an Airborne Radar Approach (ARA) System utilizing various track orient techniques and operational modes. The tests were performed in the immedia NAFEC in Atlantic City, N.J. The test environment involved the airport to area and offshore sites. The test aircraft was a NASA CH53A helicopter may by Sikorsky Aircraft and currently based at NAFEC. The test period was for January 1979 to February 1979 and from June 1979 to August 1979. Flight of ARA accuracy and procedures development were performed in six distinct operations. These were as follows: beacon w/cursor, multiple beacon, skin pain paint w/cursor, combined and beacon-only modes. The specific program object be summarized as follows: 1) to evaluate the ability of the radar operator an aircraft along a predetermined path using various track orientation technique; the cursor and multiple beacon techniques; 2) to assist the FAA is and certifying standard ARA procedures and weather minimums; 3) to define quantify specific ARA system functions and characteristics for use in a Micoperational Performance Standards (MOPS) document. The primary conclusions of this flight test experiment were: the ARA performed satisfactorily from both an accuracy and an operational viewpoin six operational modes, the ARA performance utilizing the track orientation showed marked decrease in the overall Total System Cross Track (TSCT) and Technical Error (FTE) quantities; the cursor and multiple beacon technique eliminated the tendency to "home" to station; in the skin paint mode distinction of the skin paint mode distinction and the skin paint mode distinctions and the skin paint mode distinctions and the skin paint mode distinctions and the skin paint mode distinctions and the skin paint mode distinctions and the skin paint mode distinctions and the skin paint mode distinctions and the skin paint mode distinctions and the skin paint mode distinctions and the skin paint mode distinctions and the skin paint mode distin				diate area of terminal manufactured from tests for operational aint, skin ojectives can tor to guide techniques, in developing me and Minimum RA system oint in all ion techniques also
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16. Abstract

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A motion-based simulator was used to compare the flying qualities of three denotic single-rotor helicopters during a full-attention-to-flight control took. Terminal-area VOR instrument approaches were flown with and without tembulence. The objective of this NASA/FAA study was to investigate the influence of helicopter static stability in terms of the values of cockpit control gradients as specified in the existing airworthiness criteria, and to examine the effectiveness of several types of stability control augmentation systems in improving the instrument-flight-rules capability of helicopters with reduced static stability. Two levels of static stability in the pitch, roll, and yaw axes were examined for a hingeless-rotor configuration; the variations were stable and neutral static stability in pitch and roll, and two levels of stability in yaw. For the lower level of static stability, four types of stability and control augmentation were also examined for helicopters with three rotor types: hingeless, articulated, and teetering. Filot rating results indicate the acceptability of neutral static stability longitudinally and laterally and the need for pitch-roll attitude sugmentation to achieve a ratisfactory system.

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tion (RNAV); Flight Techn			Service, Springfield, VA		
(FTE); In-flight/Post-flight	•	22161.	or troop optingstore, th		
Point-in-Space (PIS); HSV	FR				
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4. Title and Subtitle		1	leperi Dere	• •
Proposed ATC System f			November 1979	
Helicopter Operations	Development P	rogram	erforming Organizat	ion Code
7. Author's:		•. '	erforming Organizati	en Repart No.
D. J. Freund, T. K. V	ickers			
9. Perferming Organization Name and Addre			Werk Unit No. !TRA	
Vitro Laboratories Divis		""	WORLDHIT NO I KA	·a) .
Automation Industries, I		11.	Centreet or Grant No	<u> </u>
14000 Georgia Avenue		l l	-FA79WA-4279	
Silver Spring, Md. 2091	0		Type of Report and I	
12. Sponsoring Agency Name and Address I			, para mapana and m	
Federal Aviation Adminis			Final Report	
Systems Research and Dev		.ce	Tandi Kepoli	
Helicopter Systems Branc			Sponsering Agency	340
Washington, D.C. 20590			ARD-330	
15 Supplementary Notes				
This effort was sponsore	d by the Syste	ms Research and De	evelopment Se	ervice. Navi-
ration and Landing Divis	ion. Peliconte	r Systems Branch	inder the di	rection of
Raymond J. Hilton, Progr	am Manager.			
16 Abstract				
A halicanter ATC coats	om for the Cul	6 a 6 Mand d	fauch Ta	
A helicopter ATC syste	and the Gul	I OI MEXICO IS SET	iortn. It	embodies a
concept of evolutionary gre	owen in four p	nases as rollows:		
Phase 1, The Present	system (period	of use: 1980). IF	R navigation	is obtained
primarily with Loran-C, or	VLF/OMEGA. B	ack-up systems are	ADF and Air	borne Weather
Radar. VOR/DME is used over	er land. ATC	is by procedural c	ontrol and s	eparation
standards because no radar	or other surv	eillance system is	available o	ff shore.
Phase 2, LOFF (Loran-	C Flight Follow	wing)(Period of Ev	aluation:198	1). The LOFF
system is placed in operat:	on for experi	mentation and eval	uation. Whi	le ATC is
still performed by procedu	al control, L	OFF will assist gr	ound control	lers by
reducing workload, improvin	ng flexibility	, etc. Experiment	s will also	be performed
on secondary radar systems	(ATCRBS & VLA	TME) to provide su	rveillance.	•
Phase 3, Augmented LOI	FF (Period of	use: 1983 and bevo	nd). IFR hel	icopters will
be able to fly direct, offse	t or segmente	RNAV routes. AT	C will be es	sentially
equivalent to the NAS. Nav	igation by Lo	ran-C will expand.	Surveillan	ce will be by
LOFF and/or secondary radar	. Area of co	ntrol will be 1.50	0' to 10 000	over entire
Gulf.		ve Ljuv	_	OTOL CHELLE
Phase 4, RNAV Traffic	Control (Peri	od of use: 1985 on	d beyond). T	FR heliconters
will be able to use any of	a number of co	ertified navioation	n systems	ATC guetame
will adapt to varying accur	acies of thee	endtowe TLV	n ajatema. 11 he heest	on surveilla
ance provided by aircraft i	enorting of w	eition information	and/or eco	ou ani verrit-
Separation standards will b	oborcing or be	ha annivelent to	u auu/or sec Northaact Co	reidor
	C reduced and		MULTHERSE CO	rridor.
17. Key Herds		18. Distribution Statement		
Helicopter ATC System		Document is ava	ilable to th	e U.S. public
Helicopter Gulf of Mexico	ATC Contain	through the Nat		
Hetropher Guit of Wexico	AIC System	tion Service, S		
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19. Security Classif. (of this report)	20. Security Clas	sif, (of this page)	21. No. of Pages	22. Price
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B. Repart No.	2. Gevernment Acce	ssion No.	. Kecipient & Catalog	Ne.
FAA-RD-80-86	AD-A089435	ŀ		
4. Title and Subtitle		3	Report Date	
Recommendations for Short-	Torm Simulatio	<u>, </u>	February 1980	
\$		""	Performing Organizat	on Cade
of ATC Concept		Į.	SA-3	
Helicopter Operations Deve	lopment Progra	ım	Performing Organizat	ion Report No.
7. Author's)				
D. J. Freund, T. K. Vicker				
P. Performing Organization Name and Address		1'). Work Unit No. (TRA	15)
Vitro Laboratories Divisio		 	1. Centract or Grant No	<u> </u>
Automation Industries, Inc	•		OOT-FA79WA-4279	,
14000 Georgia Avenue Silver Spring, Md. 20910		1	. Type of Report and I	Period Covered
12. Spansaring Agency Name and Address D	epartment of ?			•
Federal Aviation Administr	•		Final Rep	ort
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Helicopter Systems Branch		\mathbf{D}	. Sponsoring Agency (lode
Washington, D.C. 20590		<u></u>	ARD-330	
15. Supplementary Notes				
This effort was sponsored	•		-	• •
tion and Landing Division, F Raymond J. Hilton, Program N		cems branch under	the direction	or
16. Abstract	musker.			
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A number of recommendat				
study (See Report FAA-RD-78-				
for early implementation were included: (1) dual-fix hold				
and short approach paths to				
order to increase airport or				
utilizing existing parallel approaches of helicopters and CTOL aircraft was presented for consideration.				
TOT CONSTRUCTOR.				
Extensive use of flight				d in order to
reduce the time and cost of				steps of the
recommended simulation progra				
as much as possible about the				
impractical solutions before				
opment. A detailed simulation order to isolate the effection				orial design
In order to isolate the elie	-ce or changes	THE ASTITUTE PRESENT	efera.	
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17. Key Words		18. Distribution Statemen	•	
Helicopter, air traffic cont	rol (ATC),	Document is ava	llable to the !	U.S. public
simulation, holding patterns		through the Nat	lonal Technica	l Information
procedures, separation standa	ards,	Service, Spring	field VA 2210	51
	The same of	L Column and	21. No. of Pages	22. Price
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1. Report No.	2 Government Accession No.	J. Recipient's Catalog No.
FAA-RD-80-87	AD-A089407	
4. Title and Subtitle	L	5. Report Date
PRELIMINARY TEST PLANS OF	ATC CONCEPTS FOR LONGER	May 1980
TERM IMPROVEMENT (HELICOPTER OPERATIONS DE	VELOPMENT PROCRAM)	6. Performing Organization Code SA-3
	The state of the s	8. Performing Organization Report No
7. Author's) D.J. Freund T.K. Vickers		6. Performing Organization Report No
9. Performing Organization Name and Addres	15	10. Work Unit No. (TRAIS)
Vitro Laboratories Divis	ion	
Automation Industries, I	nc.	11. Contract or Grant No. DOT-FA79WA-4279
14000 Georgia Avenue		13. Type of Report and Period Covered
Silver Spring, MD 20910 12. Sponsoring Agency Name and Address	Department of Transportation	The stranger and Period Covered
Federal Aviation Adminis	tration	Final Report
Systems Research and Deve Helicopter Systems Branch		14. Sponsoring Agency Code
Washington, D.C. 20590	A	
15. Supplementary Notes		ARD=330
This effort was sponsored gation and Landing Division Raymond J. Hilton, Program	n, Helicopter Systems Branch	d Development Service, Navi- under the direction of
16. Abstract		
Test and simulation plans	ning is documented for longe	r-term improvements in
	which are classified into t	
1. Offshore Route St	ructure in the Gulf of Mexi	co
2. Secondary Radar		
3. Analysis of Navig	ation Errors in the Gulf	
	ance and Communications to	300 NM Range
	ng of Aircraft-Derived Posi	-
	ns Study in the CONUS	
	of Alternate Airports for H	-14 a.m.
		sticobters
8. Wake Vortex Separ	ation	
	·	
17. Key Words	18. Distribution State	
Longer Term ATC Concepts		available to the U.S.
copters Helicopter ATC Concepts		ough the National Technical
	22161.	Service, Springfield, VA,
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages 22. Price

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1. Report No.	2. Gevernment Accession Ne.	J. Recipient's Cetalog No.
FAA-RD-80-88,1	AD-A089521	
Réco mhendéthal Short Term AT Vol. I Summary of Short Te	C Improvements for Helicop- rm Improvements ters	S. Report Date Vol. I August 1979 Vol. II & IIIApril 1980
Vol. II Recommended Helicop Vol. III Operational Descri	ter ATC Training Material ption of Experimental Loran	6. Performing Organization Code SA-3
7. Aurhor's) Tirey K. Vickers, D.	FF) in the Houston Area J. Freund	8. Performing Organization Report Ne
9. Performing Organization Name and Addi Vitro Laboratories Divisi	on	10. Werk Unit No. (TRAIS)
Automation Industries, In 14000 Georgia Avenue Silver Spring, Md. 20910		11. Centrect or Grent No. DOT-FA79WA-4279
	Department of Transportation ration	13. Type of Report and Period Covered Final Report
Helicopter Systems Branch Washington, D.C. 20590		14. Spensoring Agency Code ARD-330
gation and Landing Divisi Raymond J. Hilton, Progra	by the Systems Research and on, Helicopter Systems Branch m Manager.	under the direction of
categorized as to those t tion or use and those tha The recommendations	t require limited short term for immediate use include: (Description of LOFF, (3) Rec	mediate operational considera- simulation or test. 1) Helicopter ATC training

major sections on Helicopter Capabilities and Limitations, on Helicopter Navigation and on Helicopter Control Procedures.

• Vol. III is the complete Operational Description of the Experimental Loran

• Vol. III is the complete Operational Description of the Experimental Loran Flight Following (LOFF) in the Houston Area. It describes both airborne and ground components and states the objectives that are being sought in the experiment.

Helicopter ATC, Helicopter A Control, Helicopter ATC Cont Training, Loran Flight Follo Helicopter Holding Patterns	roller	18. Distribution Stetement Document is available through the Nation Service, Springfice	nal Technica	l Information
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I. Resert No.		· · · · · · · · · · · · · · · · · · ·		,,
	2. Government Accession	No. [3.	Recipient's Catalog	No.
FAA-RD-80-88,II	AD-A089441			
Récommendéd'''' Short Term ATC	Improvements for	Helicop- 5.	Repert Date Vol.	I August 1979
Vol. I Summary of Short Term		ters vo	L II & III -	April 1980
Vol. II Recommended Helicopte			Performing Organisa	ion Codo
Vol. III Operational Descript			SA-3	
Plight Rollowing (LOFF) in the Houston	Area	Performing Organizat	ion Roport No.
Tirey K. Vickers, D. J.	Preund			
9. Performing Organization Name and Address Vitro Laboratories Division		10.	Work Unit No. (TRA	15)
Automation Industries, Inc.		 11 -	Contract or Great N	
14000 Georgia Avenue		. 1	OT-PA79WA-42	· ·
Silver Spring, Md. 20910		13.	Type of Report and	Period Covered
12. Spansaring Agency Name and Address D	epartment of Tran		nal Report	
Federal Aviation Administra	tion		a. mapurt	
Systems Research and Develo	ment Service			
Helicopter Systems Branch		14.	Sponsoring Agency	odo
Washington, D.C. 20590			ARD-330	
15. Supplementary Notes				
This effort was sponsored by	the Systems Res	earch and Deve	lopment Serv	ice, Navi-
gation and Landing Division	Helicopter Syst	ems Branch und	er the direc	tion of
Raymond J. Hilton, Program 1	lanager.		 	·
			_	_
The recommended Short ? in three volumes, i.e.:	Term ATC Improvem	ents for Helic	opters are d	ocumented
 Vol. I is a summary report of all improvements studied. Improvements are categorized as to those that can be recommended for immediate operational consideration or use and those that require limited short term simulation or test. The recommendations for immediate use include: (1) Helicopter ATC training material, (2) Operational Description of LOFF, (3) Recommendations concerning military training routes and (4) Survey data for use in Gulf communications and route structure planning. The recommendations for short term simulation include: (1) Dual waypoint holding patterns, (2) other holding patterns and (3) shortened entry procedures for intercepting final approach path. Vol. II is the complete training material for helicopter ATC. It contains major sections on Helicopter Capabilities and Limitations, on Helicopter Navigation and on Helicopter Control Procedures. Vol. III is the complete Operational Description of the Experimental Loran Flight Following (LOFF) in the Houston Area. It describes both airborne and ground components and states the objectives that are being sought in the experiment. 				
17. Key Words	T 18.	Distribution Statement		
Helicopter ATC, Helicopter A	ir Traffic Doc	ument is availa	able to the	J.S. public
Control, Helicopter ATC Cont	roller thr	ough the Nation	nal Technica	Information
Training, Loran Flight Follo	wing (LOPF) Ser	vice, Springfi	eld, VA 221	51
Helicopter Holding Patterns			-	-
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1. Report No.	2. Government Acces	sien Ne. 3.	Recipient's Catalog N	ie.
FAA-RD-80-88,III	AD-A089385			
Recommended " Short Term ATC	Improvements	for Helicop- 5.	Report Date Vol.	I August 1979
Vol. I Summary of Short Terr			1. II & III -	
Vol. II Recommended Helicopte	er ATC Trainin	g Material 6.	Performing Organizati	en Cede
Vol. III Operational Descrip				
Flight Following (LOF)	F) in the Pous	ton Area 8.	Performing Organizati	en Repart Ne.
Tirey K. Vickers, D. J	. Freund		SA-3	
9. Performing Organization Name and Address		10	. Werk Unit Ne. (TRAI	\$)
Vitro Laboratories Division				
Automation Industries, Inc	•	[11	. Contract or Grant No	
14000 Georgia Avenue		-	DOT-FA79WA-42	79
Silver Spring, Md. 20910			Type of Report and I	Period Covered
12. Spensering Agency Name and Address De	partment of T	ransportation 1	inal Report	
Federal Aviation Administra	tion			
Systems Research and Develo	pment Service	174	Spensering Agency C	'ada
Helicopter Systems Branch			ARD-330	
Washington, D.C. 20590				
This effort was sponsored h	v the Systems	Research and Dev	elopment Serv	ice. Naviga-
tion and Landing Division,				
Raymond J. Hilton, Program				
16. Abstract				
The recommended Short	Torm ATC Imor	ovements for Weld	conters are d	ocument ed
in three volumes, i.e.:	Term wie impi	ovements for her	copters are d	ocumented.
 Vol. I is a summary report of all improvements studied. Improvements are categorized as to those that can be recommended for immediate operational consideration or use and those that require limited short term simulation or test.				
17. Key Words		18. Distribution Statement		
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1. Report No. 2 FAA-RD-80-107	AD-A091156	3. Recipions's Catalog No.
4. Title and Saturile Study of Heliport Airspace and Real Estate Requirements 7. Author's) A. G. DeLucien, F. D. Smith		5. Report Date August 1980
		6. Performing Organisation Code SSED/FSG
		PAR-037-80
PACER Systems, Inc., Suite 510 1755 South Jefferson Davis Highway Arlington, VA 22202		18. Work Unit No. (TRAIS)
		11. Contract or Grant No. DOT-FA-79WAI-019
12. Spansoring Agency Name and Address U.S. Department of Transportation Federal Aviation Administration Systems Research and Development Service Washington, D.C. 20591		13. Type of Report and Period Covered Final Report March 1980 to July 1980
		14. Sponsoring Agency Code FAA/ARD-330
15. Supplementary Hotes		

16 Aberreet

This report documents the review and evaluation of real estate and airspace requirements as set forth in applicable U.S. heliport design criteria. International criteria are reviewed to discern their rationale for various requirements. Helicopter performance during normal and failure-state operations is analyzed. The suitability of current criteria is examined with respect to various operational profiles. Modifications to current criteria are suggested which would accommodate various operational requirements and varying levels of terminal instrument procedures capability. Recommendations include a revised heliport classification scheme with corresponding changes to real estate and airspace criteria for IFR operations; helicopter performance chart standardization for flight manuals with specific data requirements; consideration of obstacle clearance for failure-state operations; additional criteria for offshore facilities; and revised criteria for elevated heliports/ helipads.

Helicopter, Heliport, Real Estate, Airspace, Obstacle Surfaces, Terminal Instrument Procedures, Criteria		This document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161.		
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1. Report No.	2. Government Acces	sion No. 3.	Recipient's Catalog N	ō
FAA-CT-80-175				
4. Title and Subtitle	5.	Report Date		
LORAN-C Nonprecision Appro		July 1980. Performing Organization		
Northeast Corridor	Northeast Corridor			
		<u>. </u>		
7. Author's)		8.	Performing Organization	n Report No.
Frank Lorge		10	FAA-CT-80-175 Werk Unit No. (TRAIS	:\
9. Performing Organization Name and Addres		10.	WORK UNIT NO. (IRAI:	· ·
Federal Aviation Administr	ation	71	Contract or Grant No.	
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Atlantic City, New Jersey	00405	13.	Type of Report and P	eriad Covered
12. Sponsoring Agency Name and Address			7,7	
Federal Aviation Administ	ration		Project Plan	
Systems Research and Deve			rrojeco rran	
Washington, D.C. 20590	10pmeno bervi	14.	Sponsoring Agency Co ARD-300	od•
15. Supplementary Notes			 ,	
16. Abstract				
This flight test plan is	designed to de	stermine the suits	hility and ac	ourson of
LORAN-C nonprecision appr	paches for hel	icopters in the N	Northeast Carr	idor
Results will be compared	with Advisory	Circular (AC) 90-	-45A requireme	nts for
total system accuracy. C	onclusions wil	l be drawn with a	regard to the	accuracy
of LORAN-C nonprecision a	pproaches for	helicopters. Spe	ecific objecti	ves are:
		-		
a. To collect data	on LORAN-C sys	tem errors to sur	port decision	s relative
to possible certification	of LORAN-C fo	r nonprecision ap	proaches in t	he Northeast
Corridor.				
1 7 1 10				
		data on performa		
nonprecision approaches a	na missea appr	oacnes in the Nor	theast Corrid	or.
c. To obtain data o	n flight teahn	ical error associ	atad with IOD	ANY C
nonprecision approaches.	i iiignt teenn	rear error associ	aced with Long	HLV=C
nonprecision approaches.				
d. To obtain data or	n area propaga	tion anomalies in	the Northeas	t Corridor.
	FE			
e. To obtain perfor	mance and oper	ational data on I	ORAN-C using	various
triad configurations for			9	
	•	3 . 4		
f. To obtain data or	LORAN C SÍGN	al strength and a	val ability.	
17. Key Words		·	on file at the	Technical
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Helicopter Flight Tech	Treat PLIGE			
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FAA-CT-80-210	AD-A094175		
4. Title and Subtitle		5. Report Date	
HELICOPTER ICING REVIE	W	September 1980	
		6. Performing Organization Code	
		8. Performing Organization Report No.	
7. Author(s) A. A. Peter	son and L. U. Dadone	D210-11583-1	
9. Performing Organization Name or	d Address	10. Work Unit No. (TRAIS)	
Boeing Vertol Company		·	
A Division of The Boei	ng Company	11. Contract or Grant No.	
P.O. Box 16858		DOT_FA78WA-4258	
Philadelphia, Pennsylv	ania 19142	13. Type of Report and Period Covered	
12. Spansoring Agency Name and Ac	dress		
U.S. Department of Tra	nsportation	Final Report	
Federal Aviation Admin	istration	30 Sept. 78 - 31 July 80	
Technical Center		14. Sponsoring Agency Code	
Atlantic City Airport,	New Jersey 08405	<u> </u>	
15. Supplementary Notes			

The development of techniques and criteria permitting the release of a helicopter into known (i.e., forecast) icing situations is actively being investigated by both military and civilian agencies through ongoing test programs and study efforts. As part of this overall effort, helicopter icing characteristics, available ice protection technology, and test techniques are discussed in this technical treatment. Recommendations are provided in the areas of icing certification procedures and icing research.

One of the key issues addressed in this report is the test environment, i.e., the use of inflight evaluation in natural icing only, or, the use of a simulated icing environment to supplement and/or expand the certification envelope. Involved in this issue is the shape (and extent) of the rotor ice (natural vs simulated) as it affects the aerodynamics and dynamics of the rotor system, together with the shedding characteristics as it affects the behavior and safety of the complete vehicle.

17. Key Words Helicopter Ice Protection Icing Certification Icing Environment Icing Research Rotor Icing		18. Distribution Statement Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161		
19. Security Classif. (of this report)	20. Security Cles	sil. (of this page)	21. No. of Pages	22. Price
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Repent No. 2. Government Accession No. 1. Responsible No.		13.6		3. Recipient's Catalog No.	
Three Cue Helicopter Flight Directors: An Annotated Bibligoraphy 7. Authority 8. Performing Organization Code T. Pott, J.P. McVicker, H.W. Schlickenmaier 9. Performing Organization Research No. FAA-RD-81-7-LR 10. Work Unin No. (TRAIS) 11. Contractor of Great No. Systems Research and Development Service Washington, D.C. 20590 12. Sponstring Agercy Near and Period Covered Washington, D.C. 20590 13. Supplementer Notes 14. Sponstring Agercy Near and Development Service Washington, D.C. 20590 15. Supplementer Notes 16. Abstract The helicopter community has a need for adequate instruments for safe instrument flight. The three-cue flight director has been found to be suitable during Instrument Meteorological Conditions. With the increased use of flight directors by civil operators, questions have been raised regarding the collective command's (the third cue) sensing. A literature search was conducted to determine what work had been done with the collective display format. 17. Ker words 18. Distribution Statement 19. Security Classified 19. Security Classified 10. Security Classified 10. Work Univ. No. (TRAIS) 11. Contractor Great No. 11. Contractor Great No. 12. Proceeding Organization 13. Supplementary Notes 14. Sponstring Agercy Code ARD-300 15. Supplementary Notes 16. Abstract 16. Abstract 17. No. of Pages 122. Proce 18. Security Classified 18. Distribution Statement 19. Security Classified 19. Security Classified 19. Security Classified 10. Preferming Organization Code 10. Work Univ. No. (TRAIS) 10. Work Univ. No. (TRAIS) 11. Contractor Great No. 11. Contractor Great No. 11. Contractor Great No. 12. Proceeding Organization 13. Supplementary Notes 14. Sponstring Agercy Notes 15. Security Classified 16. Abstract 17. No. of Pages 122. Proce 18. Security Classified 18. Security Classified 19. Security Classified 10. Security Classified 10. Security Classified 10.	1. Report No.	2. Government Acces	sion No.	S. Weerpram & Control	
Three Cue Helicopter Flight Directors: An Annotated Bibligoraphy A. Annotated Bibligoraphy 7. Annotated Bibligoraphy 8. Performing Organization Report No. 9. Performing Organization Report No. 9. Performing Organization Report No. 9. FAA-RD-81-7-IR 10. Work Unit No. (TRAIS) 11. Convect or Grant No. 12. Supering Agrees News and Development Service Washington, D.C. 20590 13. Supering Agrees News and Address 14. Spensoring Agrees News and Address 15. Supering Agrees News and Address 16. Abstract 17. Post J. P. McVicker, H.W. Schlickenmaier 18. Type of Grant No. 19. Spensoring Agrees News and Development Service Washington, D.C. 20590 18. Supering Agrees News and Address 19. Supering Agrees News and Address 10. Work Unit No. (TRAIS) 11. Convect or Grant No. 11. Convect or Grant No. 11. Convect or Grant No. 11. Type of Report and Pariso Converted 11. Spensoring Agrees Converted 11. Spensoring Agrees Converted 11. Spensoring Agrees Converted 11. Spensoring Agrees Converted 12. Spensoring Agrees Converted 13. Type of Report and Pariso Converted 14. Spensoring Agrees Converted 15. Supering Agrees Report and Pariso Converted 16. Abstract 17. No. of Pages. 17. No. of Pages. 18. Distribution Stretment 19. Secont, Clease Lief this report 10. Secont Lief this report 10. Secont Lief this report 11. Converted to Converted this c	FAA-RD-81-7-LR				
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and nonprecision approache	s. The tot	al system accu:	racy met or ex	ceeded the
requirements of Advisory Cir	cular (AC) 90	-45A "Accuracy I	Requirements of	Area Navi-
gation Systems" for termina	l and en rou	te phases of fl	ight, provided	the proper
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9. Performing Organization Name and Address Systems Control, Inc. (Vt.) Champlain Technology Industries Division 2326 S. Congress Avenue, Suite 2-A West Palm Beach, Florida 33406	
12. Sponsoring Agency Name and Address U.S. Department of Transportation Federal Aviation Administration Technical Center Atlantic City Airport, New Jersey 08405	
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16. Abstract

An analysis of National Icing Facilities requirements was performed at the request of the Federal Aviation Administration. This effort consisted of a five-month investigation to determine the scope and character of current and future icing facilities needs. This investigation included current aircraft needs as well as facilities that might be required for icing research, development and certification testing through the year 2000.

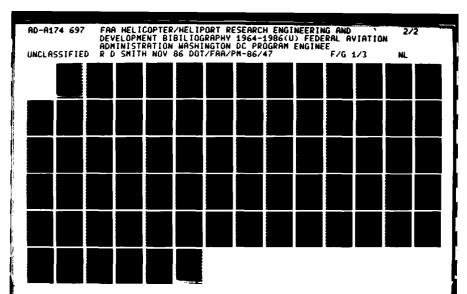
The information used for this study included all icing certification regulations for both fixed wing airplanes and rotorcraft. These regulatory requirements for icing certification were supplemented by a comprehensive analysis of current and future aircraft operational requirements. This independent facility requirements assessment was then compared to a previously published MASA review of icing facilities capabilities.

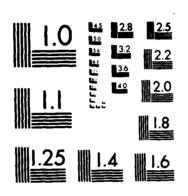
The conclusion was reached that the need for an inventory of National Icing Facilities currently exists and will become intensified in the next decade. The technical characteristics of these facilities were described and it was recommended that a joint FAA/NASA/DOD Task Force be established to formulate and spearhead the development of a National Icing Facilities Program.

17. Key Words National Facilities Icing Tests Icing Certification Meteorological Conditions Icing Similitude	through	is available to the the National Technic Springfield, VA 221	al Information
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A helicopter performance related heliport classification method is developed which accommodates an applicable range of operating conditions and factors which impact helicopter performance. Dimensional values for use in planning both real estate and airspace surfaces are determined for application to the identified heliport classifications. Those values are incorporated into generalized guidelines for heliport planners to meet site-specific and non-standard operational conditions. Requirements for flight manual performance charts and published heliport information are also identified.

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7. Author's) EDWIN D. McCONKEY	•		•	_
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16. Abstract

This report identifies the various instrument approach procedures that are available to the helicopter operator. Emphasis is placed on the recently approved "Helicopter Only" procedures, the criteria for which are contained in Chapter 11 of the Terminal Instrument Procedures Handbook.

The objective of this study was to examine currently available solutions to helicopter approach needs. The study also covers new and innovative solutions to helicopter approach requirements. This was accomplished by:

- Identifying the various navigation aids now being used which may have general application to U.S. helicopter operations.
- Describing typical locations of use, typical approach procedures, and minimums for each of these aids.
- Providing estimated equipment costs for both the ground and airborne portions of these systems.
- Discussing the rationale used to support the use of a particular aid at a particular location or in a specific operational environment.

Results of this investigation are presented in the form of a series of helicopter instrument approach options for the user.

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7. Author's) Robert J. Esposito			DOT/FAA/CT-81/73
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The purpose of this task was to develop a 3D Loran-C Navigator by configuring an interface unit between an airborne Loran-C navigator (Teledyne TDL-711) and an Altitude Alerter/VNAV Guidance system (Intercontinental Dynamics model 541). The digital computer-based interface unit was designed to allow the flight crew to specify the approach slope (3.0 to 9.9 degrees). This report documents the hardware and software in the interface unit, and interconnection with the other involved systems. The availability of accurate, three-dimensional approach guidance information at airports where no ILS is available provides significant operational advantages, to helicopter operators in particular. The 3D Loran-C navigator system was bench tested and flight demonstrated. Smooth, accurate (within the limitations of Loran-C) descent guidance information was obtained.				
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7. Author(s) E.D. McConkey, J.B. McKinley and R.E. Ace			
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16. Abstract

This report identifies ways in which the Microwave Landing System (MLS) can be utilized to aid helicopter operations. Consideration is given to the following study areas:

- helicopter instrument approach requirements by type of operation
- helicopter instrument approach requirements by operational area
- types of potential approach procedures that could be used by helicopters
- helicopter performance considerations during approach, landing and missed approach procedures
- ground and airborne MLS equipment
- benefits and costs associated with the use of MLS in helicopter operations

The operational areas considered in the study are: city centers, major hub airports, non-hub airports, remote areas, and offshore oil rig support. MLS procedures can be applied to each of these operational areas. From an economic standpoint, operations at city center heliports, major hub airports, non-hub airports, and remote areas will have benefits that exceed costs if operations counts are sufficiently large. Offshore operations will not have benefits that exceed costs due to the availability of alternative approach procedures.

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17. Key Words

NAVSTAR

Global Positioning System (GPS)

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15. Supplementary Notes

16. Abstract

This report describes a flight test designed to investigate the suitability of Loran-C as a nonprecision approach aid in the Northeast Corridor (NEC). Approaches were flown at six selected airports in the NEC by a CH-53A helicopter using Loran-C for course guidance. Accuracy criteria specified in Advisory Circular (AC) 90-45A were used as the standard for acceptability. Data were recorded for Loran in area calibrated and uncalibrated modes along with very high frequency omnidirectional radio range (VOR)/distance measuring equipment (DME) raw sensor data for comparison. The results show that the group repetition interval (GRI)-9960 Northeast U.S. Loran-C chain met AC 90-45A requirements for nonprecision approaches in all cases when a local area calibration was applied. The uncalibrated mode met AC 90-45A requirements at four of the six airports. It was determined that the Seneca, Nantucket, Carolina Beach triad should be used for navigation throughout the flight test area.

17. Key Words Loran-C Loran-C Lonprecision Approach Northeast Corridor Area Navigation (RNAV) Helicopter Navigation	public through	is available to the National T rvice, Springfi	[echnical
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With the increasing number of IFR certificated helicopters and improvements in electronic approach guidance systems, many helicopters will soon be capable of executing IFR approaches to heliports. In order to support these operations, an IFR lighting and marking system is required.

This project plan describes an effort to develop and evaluate Visual Guidance Systems to support heliport operations during Instrument Meteorological Conditions (IMC). Project to include the following:

- a. Survey of Instrument Flight Rules (IFR) heliport visual aids presently in use and review of previous flight test reports.
 - b. Development of new and modified visual guidance aids/systems.
 - c. Flight testing of the proposed system at an operational heliport.

A formal report detailing results of the developmental testing and evaluation, and giving recommendations for components and configuration of a standard IFR heliport lighting and marking system will be issued.

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7. Author's) Robert D	. Till	DOT/FAA/CT-TN83/03
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16. Abatract

The Federal Aviation Administration Technical Center conducted this test project under Technical Program Document (TPD) 04-150 to determine the operational suitability of the Navigation Satellite Timing and Ranging Global Positioning System (NAVSTAR GPS) for rotary wing aircraft. The flight tests were conducted in a CH-53A helicopter using a prototype low-cost GPS receiver, the Magnavox Z-set, over a period of performance from July 1981 to January 1982. Over 15 hours of radar tracked en route and nonprecision approach flight tests were flown with two-dimensional GPS derived guidance (crosstrack and range to go) used as the primary navigation system.

This report includes laboratory and flight test results that demonstrate perturbational effects from the following conditions: multipath, satellite shielding, user-satellite geometry, vehicle dynamics, weather, and navigation satellite constellation change. The flight test data were analyzed in this report for compliance with the requirements of Advisory Circular (AC) 90-45A and the technical and operational issues specified in the Federal Radionavigation Plan (FRP).

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7. Author's) L.D. KING AND E.D. McCO	NKEY	
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16. Abatrost

This report contains the description and results of a Loran-C flight test program conducted in the State of Alaska. The testing period was from August 1982 to September 1982. The purpose of the flight test was to identify applicable Loran-C accuracy data for the Alaskan air taxi and light aircraft operators so that a Supplemental Type Certificate (STC) can be issued in the Alaska Region for the Loran-C system tested (Teledyne TDL-711).

Navigation system errors were quantified for the Loran-C unit tested. The errors were computed from knowledge of position calculated from ground truth data and the indicated position of the navigator. Signal coverage, bias and flight technical error data were also obtained. Multilateration ground truth, photographic ground truth, and data acquisition systems were carried aboard the test aircraft.

The tests were concentrated in the southwest part of the Alaskan mainland. An interconnecting network of routes west of Anchorage and south of a line from Fairbanks to Kotzebue were flown for data collection. Of particular interest was the area around, and to the west of, Bethel where there are currently very few aids to air navigation.

The North Pacific Loran-C chain with stations at St. Paul Island (Master), Port Clarence (Yankee) and Narrow Cape (Zulu) was used in this area. Test results indicate that Loran-C has sufficient signal coverage and accuracy to support aircraft enroute navigation in much of the test area. In the area around Anchorage the test unit failed to consistently acquire and track the signal, however. Further analysis of the data and testing are required in the Anchorage area.

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16. Abetract

This report is a compilation of general aviation safety research issues extracted and summarized from recent studies conducted by the Federal Aviation Administration (FAA), other government agencies, and the aviation industry. It offers an overview of conclusions and recommendations that highlight current and future problem areas in general aviation. The report addresses the expressed needs as defined by these studies which counsel research and development relevant to the interrelationships of man, machine, and environment to effectively improve the general aviation safety record.

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supercooled cloud types and weather conditions up to 10,000 feet (3 kilometers) above ground level (Ad.) have been computerized to form a new Data Base of cloud variables applicable to low altitude aircraft icing studies. Half of the data is from the circraft (i.g. rectarch flights conducted by the National Advisory Committee for Aeronautics (NACA) in 1946-50. The other half is from recent wintertime research flights by the Naval Research Laboratory and other organizations, mostly over the conterminous United States (CONUS) and nearby offshore areas. The Data Base includes liquid water content (LWC), cloud droplet median volume diameter (MAL), true outside air temperature (OAT), horizontal extent and altitude of uniform cloud intervals as well as information on cloud type, weather conditions, date and geographic location, and other data.

A variety of analyses are illustrated which yield these principal conclusions: The MACA and modern CONUS measurements generally agree in most aspects for similar amounts of data in similar cloud and weather conditions. The Intermittent Maximum and Continuous Maximum "envelopes" in the Federal Aviation Regulations. Part 25 (FAR-25), Appendix C, do not correctly describe the icing environment for altitudes up to 10,000 feet AGL. The average ice accretion rate appears to be independent of altitude between 2000 and 10,000 feet AGL.

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16. Abstract

long envelopes which effectively characterize supercooled clouds from ground level to 10,000 feet above ground level over the conterminous United States have been generated from a new data base of aerial observations. This data base, recently established via an Interagency Agreement between the FAA and the Naval Research Laboratory is the largest, most significant compilation of low-altitude supercooled characteristics currently in existence. It is intended that this new characterization serve as a basis for the establishment of design criteria and regulations that pertain to ice protection systems and equipments for low performance aircraft which typically operate below 10,000 feet. This new characterization groups the supercooled cloud properties for all cloud types observed into three temperature ranges and presents their associated values of liquid water content (LWC), range of median volume droplet diameters (MVD), and icing event duration. Details of the analysis process are discussed which use a least squares logarithmic regression estimation technique to predict the extreme values of supercooled cloud properties.

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16. Abstract

Rotorcraft operating characteristics may require a collision avoidance system to perform a substantially different function than is provided to conventional fixed wing aircraft by Traffic Alert and Collision Avoidance System (TCAS) I or the Minimum TCAS II. This paper has been prepared to provide analysis of environmental conditions and operational characteristics of near mid-air collision situations involving rotorcraft. The analysis is intended to provide data in establishing preliminary human factors and procedural design requirements for a rotorcraft collision avoidance system. The information should be used to establish TCAS Rotorcraft Program experimental requirements.

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DETERMINE OPTIMUM COURSE W	IDTH	<u>l</u>	ACT-140		
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Washington, D.C. 20590					
15. Supplementary Notes	•		•	1	
This flight test plan describes the methodology for determining an optimum azimuth and elevation course width for Microwave Landing System (MLS) approaches to a collocated MLS installation at a heliport. The flights will be conducted at the Federal Aviation Administration (FAA) Technical Center, Atlantic City Airport, New Jersey, using a UH-1H helicopter. This effort will provide a data base for determining the course width to be utilized in future helicopter MLS flight test activity scheduled to be conducted at the Technica Center. The data collection and data reduction and analysis of the flight ted data are discussed, and a schedule for the completion of the associated tasks is presented.					
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7 Author(a)			erforming Organizati	on Report No
C.W.Schwartz, M.W.Witcz	y			
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15. Supplementary Notes

16 Abatruct

This report presents a heliport wind assessment methodology for evaluating and potentially minimizing the influences of building-induced wind on heliport operations.

Descriptions and illustrations of wind flow patterns and characteristics for both isolated and multiple building configurations are provided to assist heliport planners, operators, and helicopter pilots in understanding the problems associated with building-induced winds. Based on geometric flow patterns, general guidelines for ground level and rooftop heliport placement are provided.

Additional guidelines for determining the area of wind influence about isolated and multiple building configurations are detailed. Rules for calculating the distance from the sides of buildings for heliport siting is provided, as well as, rules for calculating the area of influence from any wind direction. Lastly, rules are defined for calculating the area of influence of buildings with respect to the prevailing climatic wind conditions.

Recommendations are delineated for further data gathering and evaluation to validate and enhance the heliport wind assessment methodology.

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Heliport Helicopters Wind Flow Turbulence Downstream Wakes	through the Nationa	This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.	
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Helicopter Program, APM-7	20; Washington,	ת מפחל <i>ה</i> ת	AA/APM-720	
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Prepared under FAA/NWS In	terscency Acres	ment No. DTFA01-83-	.Y-20625 mar	aced
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6. Abstract				
Details are given on how objective methods such as new nonlinear approach.				
7. Key Werds Short-range forecasts Strotistical forecasts Markov		Document is avai through the Nati Service, Springs	onal Technic	al Informatio
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Paul Jones			DOT/FAA/CT-TN84/34
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the test and evaluation contains recommendations suitable for installation	procedure and position and inservice udes front and r	rovides prelision helic evaluation ear approach	This report outlines details of liminary test results. It also opter approach lighting system at IFR demonstration heliports. In lights, enhanced pad perimeter
Wey words Heliports Vistal Guidance Approach Lighting			on file at the Technical rary, Atlantic City Airport,

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		ram was conducted jointly by
		earch and Development Activity
		ject Engineer/Pilot: Paul S. Demke
16. Abstract	:	
Systems (MLS) precision heli (IMC) for minimally equipped was deceleration distance an range rate, and elevation an eight subject pilots to comp Administration (FAA) Technic were required to fly hooded, capture and DH, to a visual availability was not consider the elevation angle to a descrequires that the antenna sy a location in front of the hof increasing elevation angle reach the heliport). For a be reached which requires that the heliport to locations distance as a function of descrete and the heliport of the helipo	port approaches during instantial helicopters. The dependent of the independent variables agle. Twenty-eight data flipleta, were conducted at the al Center parallel to runwal inbound 125° or 310° azimu deceleration landing to fulled as a constraint in this sired DH is increased, an analysem be moved from a location of the helicopter must given elevation angle, as the MLS antenna again be in front of the heliport. Cereasing decision height.	ghts, using 56 flight hours and Federal Aviation by 13/31. The subject pilots ath, through elevation angle 1 stop. Real estate study. The data show that as
17. Key Words Heliport MLS Collocated MLS/Heliport	•	rary, Atlantic City Airport, 08405
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7. Authoria)			202/24/42 200/4/2
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16. Abstract

This document describes the data collection methodology, and the results obtained from the Traffic Alert and Collision Avoidance System (TCAS) User Survey. The survey was conducted during the fall, spring and early summer of 1984. The survey examined helicopter operator and pilot responses in three particular areas of interest: 1) The nature of helicopter near mid-air collision encounters, 2) Pilot Display Preferences, and 3) User price thresholds for a helicopter TCAS.

The survey revealed that only a small percentage of near mid-air collisions involving helicopters are reported, although pilots assert that mid-air collisions pose a significant hazard to flight safety. This report contains breakdowns, by operator group, of significant characteristics of helicopter operations and their associated NMAC hazards which should be addressed in the design of a helicopter specific TCAS.

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Tile and Schools MICROMAVE LANDING SYSTEMS FOR HELIPORT OPERATORS, OWNERS AND USERS Aumer's) Armer's) Kristen J. Venezia, Edwin D. McConkey Festering Organization Name and Address Systems Control Technology, Inc. 2326 S. Congress Ave., Suite 2-A Micromat Safety and Airport Technology Helicopter Program, APM-720 Boo Independence Ave., S.W., Washington, D.C. 20591 Abstract This document contains information on the utilization of the Microwave Landing System (MLS) at heliports and helipads. It was designed to familiarize heliport operators and users with the features of the MLS and its capabilities in supporting heliport operations. For this reason the major sections of the document present information on MLS stiting, operational characteristics, selecting and specifying an MLS system. In addition, other sections provide additional MLS information to familiarize pilots with MLS avionics, pilot training requirements and aircraft performance considerations. Ke, Merde Microwave Landing System Microwave Landin	1. Report No.	2. Gevernment Accession No.	J. Recipient's Catalog No.
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16. Abstract

An Automated Weather Observing System (AWOS) will be installed at the Federal Aviation Administration (FAA) Technical Center's interim Concept Development Heliport, Atlantic City Airport, New Jersey. This test plan describes the methodology for installation and determination of optimum siting of an AWOS at a heliport. The resulting siting and installation criteria will be incorporated in DOT/FAA Order 6560, "Installation and Siting Criteria for Automated Weather Observing System (AWOS)," paragraph 14, which has been reserved for applicable heliports. Data collection, reduction, and analysis of test data are discussed and a schedule for completion of tasks is presented.

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16 Abstract

This report documents the Federal Aviation Administration (FAA) Techical Center's Helicopter Terminal Instrument Approach Procedures (TERPS) project. This project was undertaken in response to the Aviation Standards National Field Office (AVN) to provide data for use in streamlining and updating chapter 11 of the TERPS manual.

Data were collected for Instrument Landing System (ILS) and very high frequency omni-directional radio range (VOR) precision and nonprecision approaches. Data collection was performed using helicopters from various weight classes.

After the data were collected, it was reduced and formatted and forwarded to AVN for analysis and use in the updating of helicopter TERPS criteria.

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The U.S. Army Aviation Systems Command (USAAVSCOM) conducts airworthiness qualification testing on aircraft under artificial and natural icing conditions. A JCH-47C helicopter with a Helicopter Icing Spray System (HISS) installed is used for generating a simulated natural icing environment. The artificial icing tests are followed by natural icing tests to assure a wide variety of flight conditions are tested and to verify artificial icing test results. The JCH-47C/HISS has been used since 1974 for conducting research, engineering, development, and qualification testing for U.S. Army, U.S. Navy, NASA, and various contractor aircraft. The USAAVSCOM has compiled an extensive artificial and natural icing test data base. The data is summarized in this report. Detailed time histories of selected natural icing encounters have been provided under separate cover to the Federal Aviation Administration (FAA).

This report documents unclassified U.S. Army, other U.S. Government agencies, and commercial icing test programs. Also discussed is the use of deice and anti-ice systems; the impact of ice accretion and shedding characteristics, performance considerations, stability and control, and vibration characteristics; and the cloud parameters measurement equipment and test aircraft instrumentation used for documenting test data. The test methodology and requirements used for qualifying aircraft for flight into icing conditions, instrumentation, and special equipment are summarized, and the details for test conducted are contained in the references. The report documents in part 14 years of U.S. Army experience in conducting in-flight aircraft icing tests and is provided to the FAA under interagency agreement in the preparation of manuals and other documents relative to the certification of civil aircraft as appropriate.

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for issuing advisories, the bearing accuracy, and the display symbology. Several recommendations for adapting TCAS to the rotorcraft environment resulted from the testing.

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15. Supplementary Notes The Heliport MLS Siting Evaluation program was conducted jointly by the FAA Technical Center and the U.S. Army Avionics Research and Development Activity (AVRADA) through FAA/AVRADA Interagency Agreement DTFA01-80-Y-10530. FAA Technical Center Project Engineer - Scott Shollenberger, AVRADA Project Engineer/Pilot -

16. Abstreet Paul S. Demko.

This report documents a series of tests designed to provide a recommended range of locations for a Microwave Landing System (MLS) at a heliport to support precision approaches in instrument meterological conditions (IMC) for minimally equipped helicopters. An objective of the tests was to achieve the lowest practical decision heights (DH's). Eight subject pilots completed 36 data flights totalling 67 hours of flight time. The subjects flew simulated IMC approaches through glidepath capture and DH, to a visual deceleration landing to a full stop at the Federal Aviation Administration Technical Center heliport. Results show that for a 90-knot approach (to any of the DH's) the separation distance between the collocated MLS and the heliport (i.e., the MLS in front of the helipad) is 1400 feet. For a 60-knot approach the separation distance is 550 feet. Data also illustrated that for the 90-knot approaches a lateral separation of the inbound course centerline from the heliport centerline of 600 feet is satisfactory, and 400 feet is the maximum lateral separation for 60 knots. Maximum recommended glidepath angles were between 7° and 10°, depending on approach speed and DH.

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16. Abstract	 	

This report describes the Helicopter Microwave Landing System (MLS) Collocated Flight Test project recently completed by the Guidance and Airborne Systems Branch at the Federal Aviation Administration (FAA) Technical Center. It describes the flight test facilities, methodology, and addresses topics such as how flight test data are collected and its application. It also describes each of the helicopter procedures flown during the project and provides an analysis of the pilot's subjective opinions concerning the acceptability and workload associated with these procedures.

It was concluded that subject pilots were able to fly single pilot raw data guided MLS precision approaches at elevation (glidepath) angles ranging from 3° to 9° to decision heights within 0.5 nmi of the helipad, when the azimuth angular course width was set to $+3.6^{\circ}$, and the elevation angular course width was set to the magnitude of the selected elevation angle divided by 3 (SEL/3).

The data presented herein also suggests that some pilot training on the techniques of tracking steep glidepaths and the importance of speed control for precision approaches to a helipad are required.

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16. Abstract

During the winter and spring of 1985, the Federal Aviation Administration (FAA) Eastern Region in conjunction with the Guidance and Airborne Systems Branch at the FAA Technical Center conducted a demonstration of a Microwave Landing System (MLS) located at a downtown heliport.

This report describes both the industry/user and FAA Technical Center activities during the evaluation period. It describes the evaluation methodology and addresses topics concerning both technical and operational issues. It also describes the helicopter procedures flown during this evaluation and provides an analysis of signal coverage and the user's subjective opinions concerning the acceptability and perceived workload associated with these procedures.

It was concluded that MLS to heliports is a viable asset to the helicopter Instrument Flight Rules (IFR) community, however, its full benefits may not be realized in the Battery Park/Wall Street area without revisiting the necessity and demand for the New York Terminal Control Area (TCA) Visual Flight Rules (VFR) operating exclusion area.

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16. Abatract

Results of part 1 of a three-part Traffic Alert and Collision Avoidance System (TCAS) evaluation are contained in this report. Part 1 evaluation consisted of the installation and initial checkout of a TCAS Experimental Unit (TEU) in a Sikorsky S-76 helicopter.

The results show that the installation was verified except for an unintended 15 decibel (dB) loss in the top mounted antenns.

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16. Abetract

This report contains the results of bench tests which were performed on the Traffic Alert and Collision Avoidance System (TCAS) Experimental Unit (TEU) delivered by the Massachusetts Institute of Technology (MIT) Lincoln Laboratory. The TEU was used in the Technical Center's helicopter TCAS flight test evaluation.

The results show that the TEU was functioning as designed.

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A preliminary flight investigation was carried out to highlight deficiencies of helicopters handling qualities when performing low speed instrument approaches. Steep decelerating MLS approaches to a decision height of 50 feet, simultaneously decelerating to 20 knots, were performed in the NAE Airborne Simulator, a variable-stability Bell 205A helicopter.

Tracking performance, in terms of height, azimuth and speed errors was of an acceptable standard, but pilot workload was extremely high, especially during the overshoot phase. Benefits of different levels of control system augmentation were not readily apparent in this high workload environment.

In view of the results of this investigation, a follow-on program is proposed where further attempts will be made to determine the effects of display and control sophistication on pilot workload during slow-speed helicopter instrument procedures.

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OTT/FAA/PM-86/10 4. Voic and Submide Very Short Range Statistical Forecasting of Automated Weather Observations 7. Author's G. Miller, Ph.D. 9. Parlaming Organization Name and Addiess. U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Office of Systems Development, Techniques Development, Lab., 8060 13th St., Silver Spring, ND 20910 10. Sept. of Transportation Frogram Regimering and Maintenance Service Helicopter Program, APM-720; Washington, D. C. 20591 13. Septiment, Nurse managed by Weather Sensors Program, APM-720, Washington, D. C. 20591 14. Sensoring Agency Code Helicopter Program, APM-720, Aircraft Safety and Airport Technology Division. 16. Abvect short period of 10, 20, 30, 60 minutes, It uses automated surface observation elements as predictors and predictands, the model is founded on Markov assumption and utilizes multivariate linear regression as the statistical operator. Details are given on how the Generalized Equivalent Markov (GPM) model is constructed and hw it compares with other objective methods such as climatology and persistence. Tests are performed on an independent data sample. Overall, CRI succeeds in bettering persistence and does so uniformly over the 6 projection periods of 10, 20 30, 60 minutes. 16. Outschama Statement Document is available to the public through the National Technical Information Service, Springfield, Virginia 22151.	1. Report No.	2. Government Acces	sugo Ne. 3 F	Pecipient's Catalog N	lo.
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16	Abstract	····				
	In order to take full advantage of the helicopter's unique flight characteristics, enhanced terminal instrument procedures (TERPS) need to be developed for a variety of non-standard operational situations. These include non-standard landing navigation aids, precision and non-precision approach profiles, landing sites, and avionics systems. Currently, TERPS criteria are largely established by extensive flight testing. This study examined the requirements for using helicopter cockpit simulators in place of flight testing to generate data necessary for enhanced TERPS development. Specifically, this report identifies and defines which parts of TERPS may be evaluated with the present state of the art in simulator technology. The report also recommends a test plan for benchmark simulator-based TERPS evaluation of standard ILS and MLS approaches using NASA Ames helicopter simulators. Included as part of this investigation were a survey and summary of the current state in modeling of navigation systems, environmental disturbances and helicopter dynamics plus visual and motion simulation; these summaries are included as appendices.					
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16. Abrivect					
Current approved terminal instrument procedures (TERPS) do not permit the full exploitation of the helicopter's unique flying characteristics. Enhanced TERPS need to be developed for a host of non-standard landing sites and navigation aids. Precision navigation systems such as MLS and GPS open the possibility of curved paths, steep glide slopes, and decelerating helicopter approaches. This study evaluated the feasibility, benefits, and liabilities of using helicopter cockpit simulators in place of flight testing to develop enhanced TERPS criteria for non-standard flight profiles and navigation equipment. Near-term (2-5 year) requirements for conducting simulator studies to verify that they produce suitable data comparable to that obtained from previous flight tests are discussed. The long-term (5-10 year) research and development requirements to provide necessary modeling for continued simulator-based testing to develop enhanced TERPS criteria are also outlined.					
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14. Abstract

This project plan describes a series of ground simulation and flight tests designed to determine the suitability of Loran Offshore Flight Following (LOFF) in the Gulf of Mexico. LOFF is an automatic dependent surveillance system which will provide a display of traffic outside radar coverage for use by air traffic control. Equipped aircraft will have Loran receivers and an interface unit that will convert Loran derived position to a LOFF message which will then be transmitted by VHF radio. Equipment will be installed in Houston Center which will convert this LOFF message for input to the enhanced direct access radar channel. Target information will then be displayed conventionally on a controller's plan view display.

The testing described in this plan will verify operation and measure accuracy of the converter unit. Flight tests will also be conducted to determine the VHF coverage area and performance of the LOFF system in areas of radar overlap.

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16 Abstract				
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This document describes th	e work performed	to determine	whether an elect	roluminescent
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scale evaluation at the Fe	A northrow in the	dministration	n (FAA) Technical	Center.
Flight testing was conduct	ed using the EAA	1- S-76 hali		
and orbits around the 60-	foot E-L helinad	a 2-70 nello	copter to fly appr	coacnes to
	zcriptu	•		
Results of the flight test	ing showed that	the E-L syste	m has insufficier	t intensity
and rusdednate cht-oll wub	le to support ni	ghttime helid	onter operations	and there-
tote does not mattant fult	her evaluation a	t the Federal	Aviation Adminis	tration (FAA)
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eliport	ĺ	Center Libr	ary, Atlantic Cit	y Airport,
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2. Government Accession No. AD-A170793	3. Recipient's Catalog No.	
AD-A170793 4. Title and Submite Aircraft Avionics Suitable for Advanced Approach Applications Vol. I - Aircraft Fleet Equipage		
		7. Author's) Stanley Kowalski, Thomas H. Croswell
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RJO Enterprises, Inc. 4550 Forbes Boulevard Lanham, Maryland 20706		
	DTFA01-84-Y-01051 13. Type of Report and Period Covered	
on ation	Avionics Study	
800 Independence Avenue, S.W. Washington, D.C. 20591		
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APM-430 Cockpit Technology Program Office

J. P. McVicker

16. Abstract

This report catalogs the aircraft avionics suitable for advanced approach applications. The configuration and model numbers of avionics used in navigation and approaches for landing are provided for 79 different types of aircraft. Aircraft are grouped into five user communities which cover Major Air Carriers, Regional Air Carriers, Executive Jets, General Aviation Aircraft, and IFR Helicopters.

Avionics evaluation includes VOR NAVs, ADFs, DMEs, RNAVs, AFCS, weather radar and the associated display instruments. These navigation systems are the most popular units for navigation and landing in todays aircraft. ILS glideslope receivers, marker beacon systems, navigation management systems, vertical navigation systems, and long range navigation systems are not covered.

Aircraft Cockpit-Panel Avionics Equipage Navigation Avionics Navigation Instruments IFC	NAV RADAF ADF RNAV HSI RMI CDI	This document is available through the National To Service, Springfield, N	echnica	l Information
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INVESTIGATION OF HAZARDS OF HELICOPTER OPERATIONS AND ROOT CAUSES OF HELICOPTER ACCIDENTS		6. Performing Organization Cade	
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7 Author's)			
Franklin R. Taylor and Ri	chard J. Adams		
9, Performing Organization Name and Addre		10. Work Unit No. (TRAIS)	
Systems Control Technolog	g, Inc.	1). Centract or Grent No.	
1611 N. Kent Street		DTFA01- 80-C-10080/Mod. 0034	
Suite 905		13. Type of Report and Period Covered	
Arlington, VA 22209		FINAL REPORT	
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Federal Aviation Administ		October 83 - September 85	
Navigation and Landing Division Helicopter Program Branch, APM-450 800 Independence Ave. Washington D.C. 20591		14. Sponsoring Agency Codo	
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35. Supplementary Notes	Shington, D.C. 20591		
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16. Abstract

During 1983 and 1984. Systems Control Technology, Inc. conducted a survey of civil helicopter pilot organizations from throughout the United States who were involved in a wide range of helicopter operations for the purpose of determining the hazards of helicopter operations and the root causes of the high rate of helicopter accidents. The survey was administered through personal interviews, meetings, and questionnaires. The derived questionnaire data included census data, profiles of the pilots work environment and procedures and their own perspectives on the hazards of helicopter operations and root causes of helicopter accidents. These data were compared with historical National Transportation Safety Board accident reports and accident briefs to determine more specifically the root causes of helicopter accidents. The results of the analysis include a list of hazards and probable root causes of accidents, as well as technological, training and standardization remedies to the causes.

17. Key Mords		18. Distribution States	nen?	
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			Performing Organization	ın Codo
OBSERVING SYSTEM (AWOS) AT	HELIPORTS		ACT-140	
		0.	Performing Organization	n Report No.
7 Author's) Rene A. Matos, John	R. Sackett, F	Philip Shuster	50m/544/0m 04	10
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9. Parforming Organization Name and Address U.S. Department of Transpor		10.	Work Unit No. (TRAI))
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EVALUATION OF SIKORSKY S-76A		October 1986	
PROFILES FOLLOWING PRECISION	MLS APPROACHES TO A	6 Performing Organization Code	
HELIPAD AT 40 KIAS		ACT-140	
Author/a)		8. Performing Organization Report No	
Michael M. Webb		DOT / DAA / OT THIS / 13:	
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Federal Aviation Administration		August 1985-July 1986	
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5 Supplementary Notes			

16 Abetract

This report describes the "trend analysis" evaluation of the Sikorsky S-76A missed approach profiles following precision microwave landing system (MLS) approaches at glidepath angles of 3°, 6° and 7.5° at a minimum instrument meterological conditions sirspeed $(V_{\min i})$ of 40 knots indicated airspeed (KIAS). It describes the flight test facilities, methodology, and addresses topics such as how flight test data are collected and what is done with it. It also describes each of the helicopter procedures flown during the project and provides an analysis of the pilots subjective opinions concerning the acceptability and workload associated with these procedures.

It was concluded that the "trend" indicates that no current terminal instrument procedures (TERPS) criteria would be violated by reducing $V_{\min i}$ to 40 KIAS. The plots indicated that there were no penetrations of the 20:1 surface missed approach surface. The maximum deviation allowed by TERPS for the height loss at missed approach rises along a 20:1 plane which begins at the surface or 250 feet below the missed approach point. For this test that meant that the 20:1 obstacle free surface began at ground level. At most, only a 40-foot fly under at decision height (DH) was noticed during the 24 missed approaches flown.

However, this information should be considered indicative rather than conclusive due to the small sample size (24 approaches). Additional testing would be required to provide TERPS quality data.

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MLS Helicopter Helicopter Certification Precision MLS Approaches	Document is on Center Library, New Jersey 0840	file at the Technical , Atlantic City Airport, 05
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AAM-500 Biomedical and Behavioral Sciences Division

APM-450 Navigation and Landing Division, Helicopter Program Branch

16. Abstruct

Aviation accident data indicate that the majority of aircraft mishaps are due to judgment error. This training manual is part of a project to develop materials and techniques to help improve pilot decision making. Training programs using prototype versions of these materials have demonstrated substantial reductions in pilot error rates. The results of such tests were statistically significant and ranged from approximately 10% to 50% fewer mistakes.

This manual is designed to explain the risks associated with helicopter flying activities, the underlying behavioral causes of typical accidents, and the effects of stress on pilot decision making. It provides a means for the individual pilot to develop an "Attitude Profile" through a self-assessment inventory and provides detailed explanations of pre-flight and in-flight stress management techniques. The assumption is that pilots receiving this training will develop a positive attitude toward safety and the ability to effectively manage stress while recognizing and avoiding unnecessary risk.

This manual is one of a series on Aeronautical Decision Making prepared for the following pilot audiences: (1) Student and Private (2) Commercial (3) Instrument (4) Instructor (5) Helicopter (6) Multi-Crew.

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16. Abstract		
Fifteen pilots each flew 24 videotaped briefing while we device. Tests were flown a Approach angles were 3°, 6° ground tracker. Airborne of TSE, FTE, and NSE. A comprafter flight. It was found acceptable, the 9° angle was A two-pilot crew would be of loss below the DH on missed	using the 1020 IMC simulat the FAATC, Atlantic (), and 9°. Tracking of data were also recorded rehensive pilot question that while 3 and 6° and a not. Course sensitives irable for IFR operations.	lator, a new view limiting City, New Jersey. aircraft was by laser . Analyses were made of nnaire was accomplished pproach angles were vity used was acceptable.
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Helicopter Approach Helicopter Missed Approach MLS Approach Helicopter MLS		
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